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EXTERNAL STORE AIRLOADS PREDICTION TECHNIQUE.

VOLUME II. DETAILED DATA.

BOOK 5. MER CARRIAGE AXIAL FORCE AND ROLLING MOMENT PREDICTIONS AND TER CARRIAGE PREDICTIONS.

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4.5 AXIAL FORCE

4.5.1 Basic Airload

The basic airload equations for multiple carriage axial force slope and intercept are presented and derived in a manner similar to the single store case. The intercept prediction requires an isolated store $C_{A_{\alpha=0}}$ value obtained from either the prediction technique of Subsection 2.2.1 or test data, just as in the single store method.

4.5.1.1 Slope Prediction

The prediction of axial force slope $\left(\frac{AF}{q}\right)_\alpha$ is divided into two cases of (1) fuselage centerline-mounted and (2) wing-mounted stores for Mach numbers between 0.5 and 1.6.

FUSELAGE CENTERLINE-MOUNTED STORES

MER STATIONS 2,4, and 6 (MS2,4,6):

$$\left(\frac{AF}{q}\right)_{\alpha_{\text{℄}_{MS2,4,6}}} = C_{A_{\alpha_{\text{℄}_{INST\ MS2,4,6}}}} \cdot S_{REF}$$

where:

$C_{A_{\alpha_{\text{℄}_{INST}}}}$ - Variation of installed C_{A_α} for forward cluster stores with Mach number, $\frac{1}{deg}$, Figure 761.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

MER STATIONS 1,3,and 5 (MS1,3,5):

$$\left(\frac{AF}{q}\right)_{\alpha_{\text{℄}_{MS1,3,5}}} = \left(\frac{AF}{q}\right)_{\alpha_{\text{℄}_{MS2,4,6}}} \cdot K_{A/F_\alpha}$$

where:

$\left(\frac{AF}{q}\right)_{\alpha_{C_{MS2,4,6}}}$ - Value of axial force slope obtained from preceding equation for forward cluster stores at the desired Mach number, $\frac{ft^2}{deg}$

K_{A/F_α} - Correction factor ratio of aft store to forward store slope plotted versus Mach number, Figure 762.

WING-MOUNTED STORES

MER STATIONS 2,4 and 6 (MS2,4,6):

$$\left(\frac{AF}{q}\right)_{\alpha_{MS2,4,6}} = \left(C_{A_{\alpha_{INST_{MS2,4,6}}}} + \Delta C_{A_{\alpha_{INTF_{MS2,4,6}}}}\right) K_\eta S_{REF}$$

where:

$C_{A_{\alpha_{INST}}}$ - Variation of installed C_{A_α} for forward cluster stores with Mach number, $\frac{1}{deg}$, Figure 763.

$\Delta C_{A_{\alpha_{INTF}}}$ - Incremental change in the installed C_{A_α} due to the interference effect of the fuselage for high-wing aircraft, $\frac{1}{deg}$, Figure 765.

K_η - Correction factor for spanwise MER location, Figure 764.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

MER STATIONS 1,3,and 5 (MS1,3,5):

$$\left(\frac{AF}{q}\right)_{\alpha_{MS1,3,5}} = \left(\frac{AF}{q}\right)_{\alpha_{MS2,4,6}} K_{A/F_\alpha}$$

where:

$\left(\frac{AF}{q}\right)_{\alpha_{MS2,4,6}}$ - Value of axial force slope obtained from preceding equation for forward cluster stores at the desired Mach number, $\frac{ft^2}{deg}$.

K_{A/F_α} - Correction factor ratio of aft store slope to forward store slope plotted versus Mach number, Figure 762.

Example:

Calculate $\left(\frac{AF}{q}\right)_\alpha$ for an M117 on MER Station 6 of a fully loaded MER on the A-7 center pylon at M = 0.7.

Required for Computation:

$S_{REF} = 1.42\ ft^2$

$\eta = .418$

$\eta' = .353$

$C_{A_{\alpha_{INST}}}$ MS6 $= -.0340$ -Figure 763

$\Delta C_{A_{\alpha_{INTF}}}$ MS6 $= 0.0$ -Figure 765

$K_\eta = 1.0$ -Figure 764

Substituting,

$$\left(\frac{AF}{q}\right)_{\alpha_{MS6}} = (-.034 + 0)(1.42)(1.0) = -.0483\ \frac{ft^2}{deg}$$

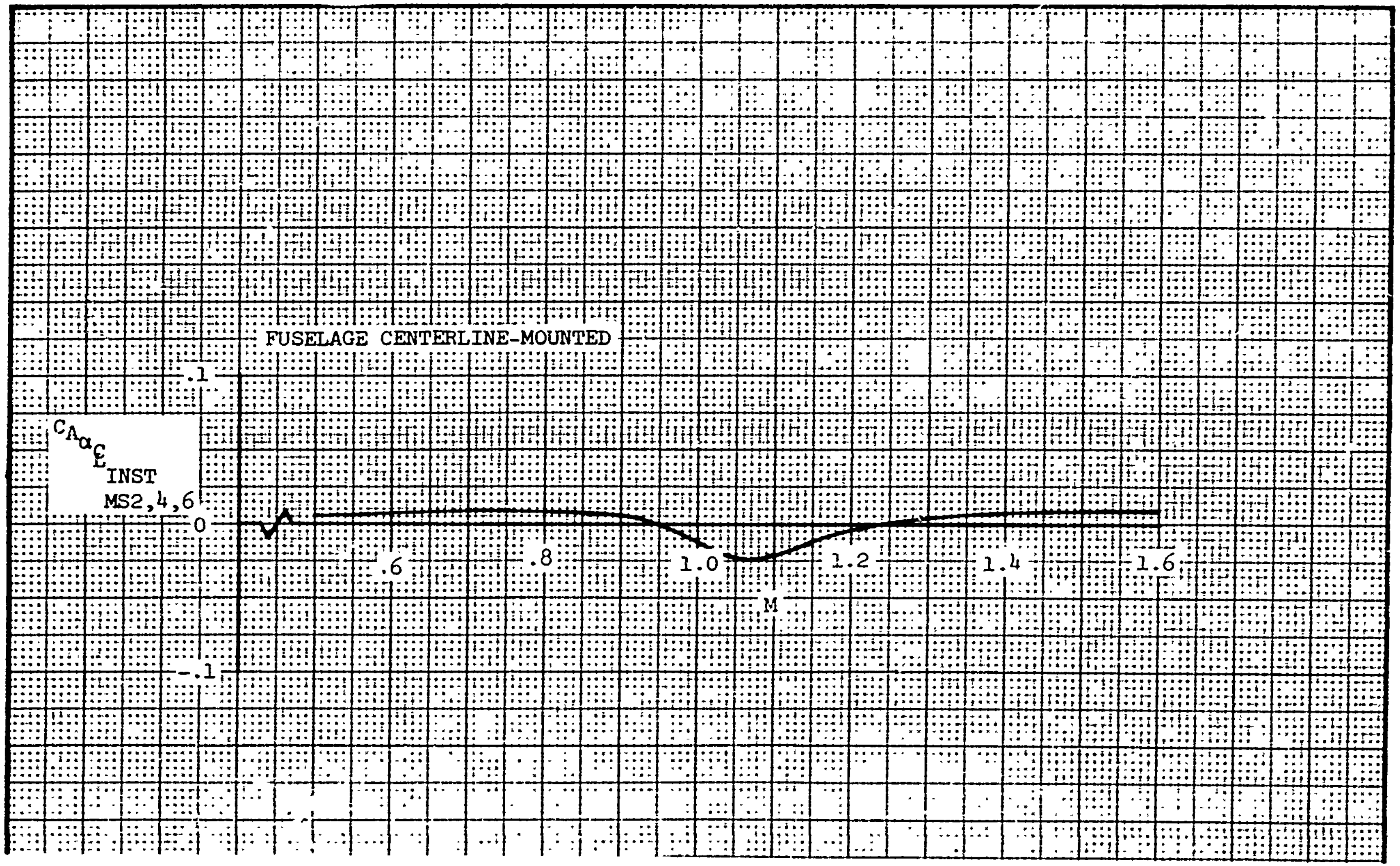


Figure 761. Axial Force Slope - Installed Coefficient for MER Stations 2,4 and 6 on Fuselage Centerline

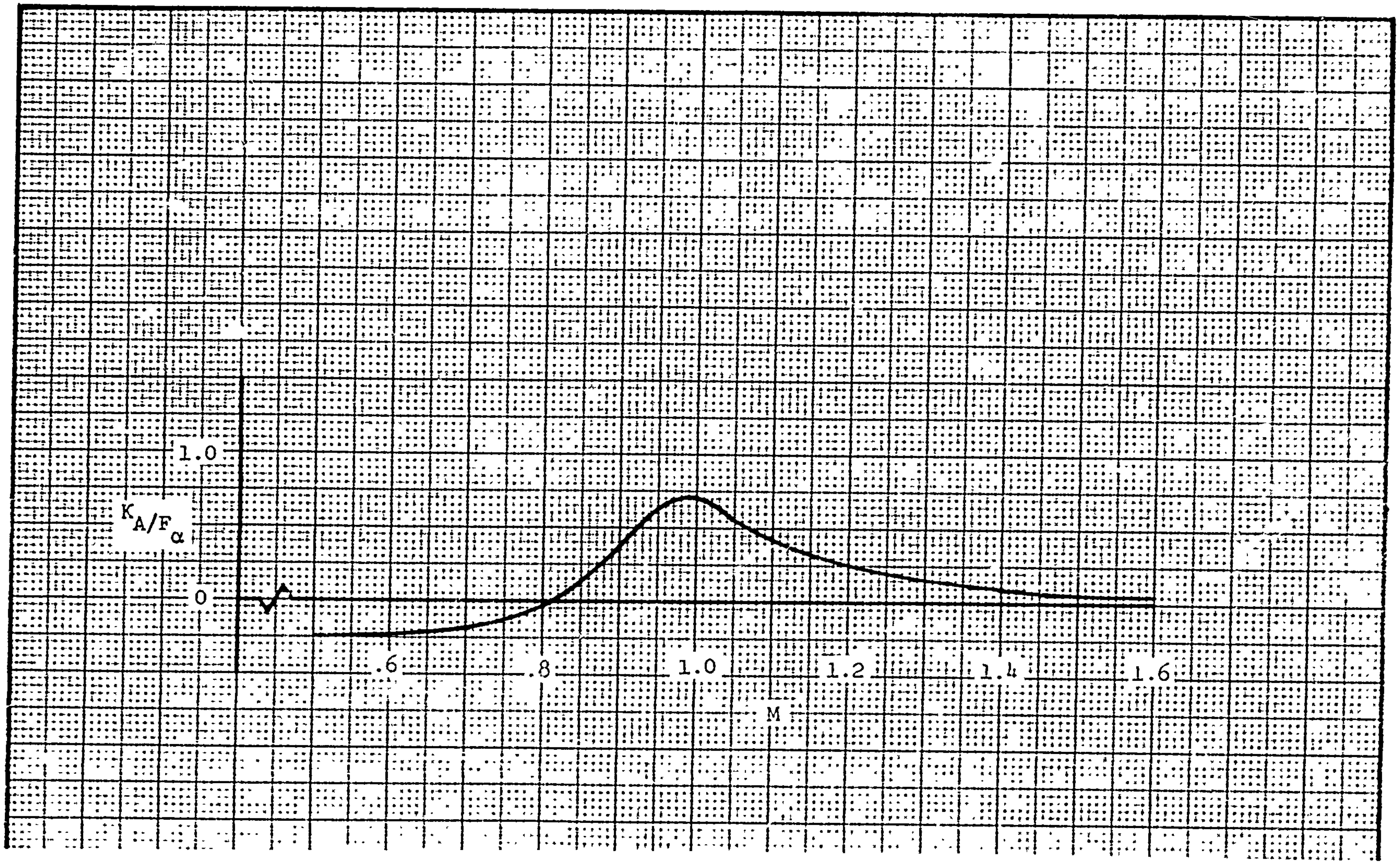


Figure 762. **Axial Force Slope** - Aft Cluster Correction

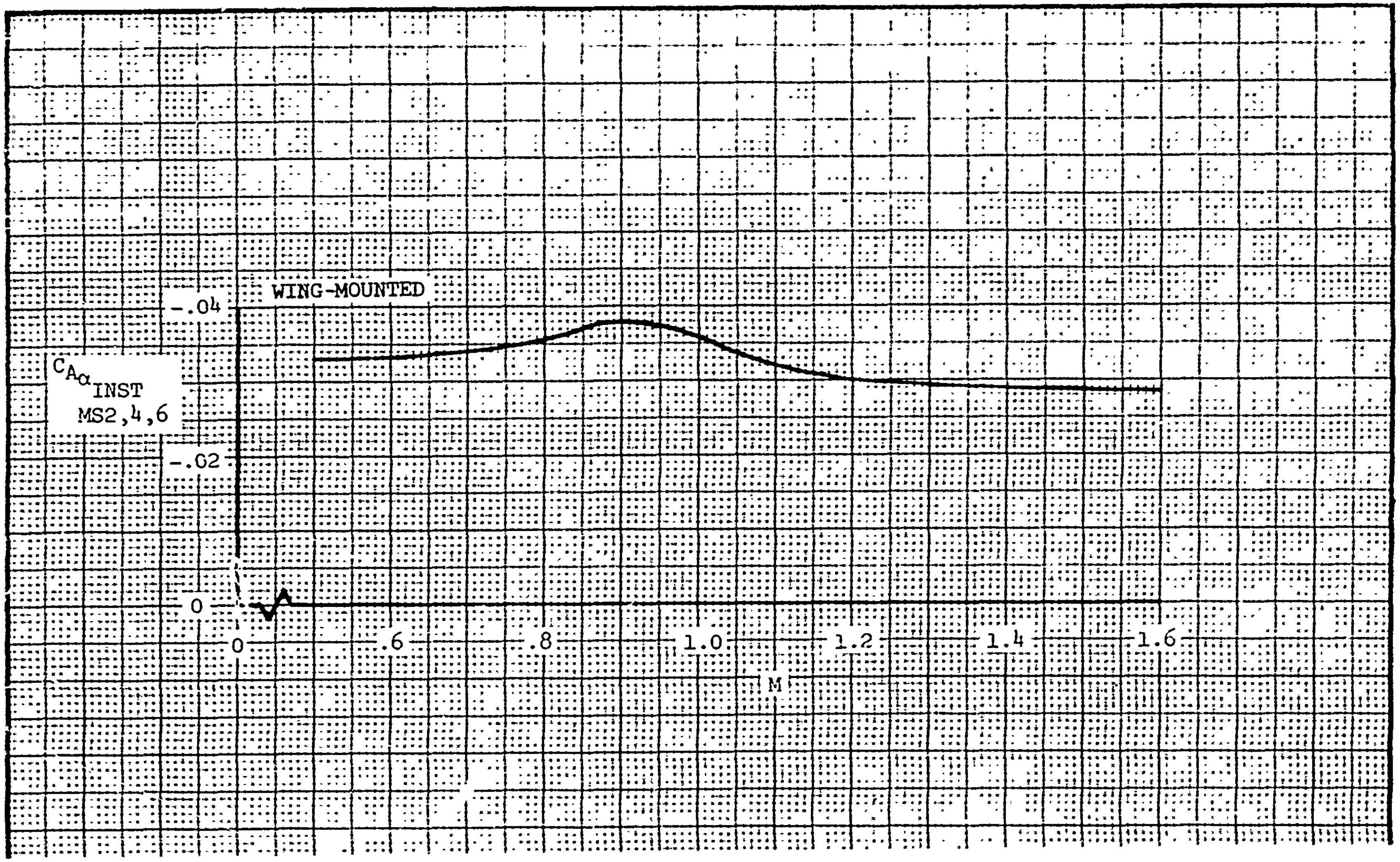


Figure 763. Axial Force Slope - Installed Coefficient for MER Stations 2, 4 and 6 for Wing-Mounted Stores

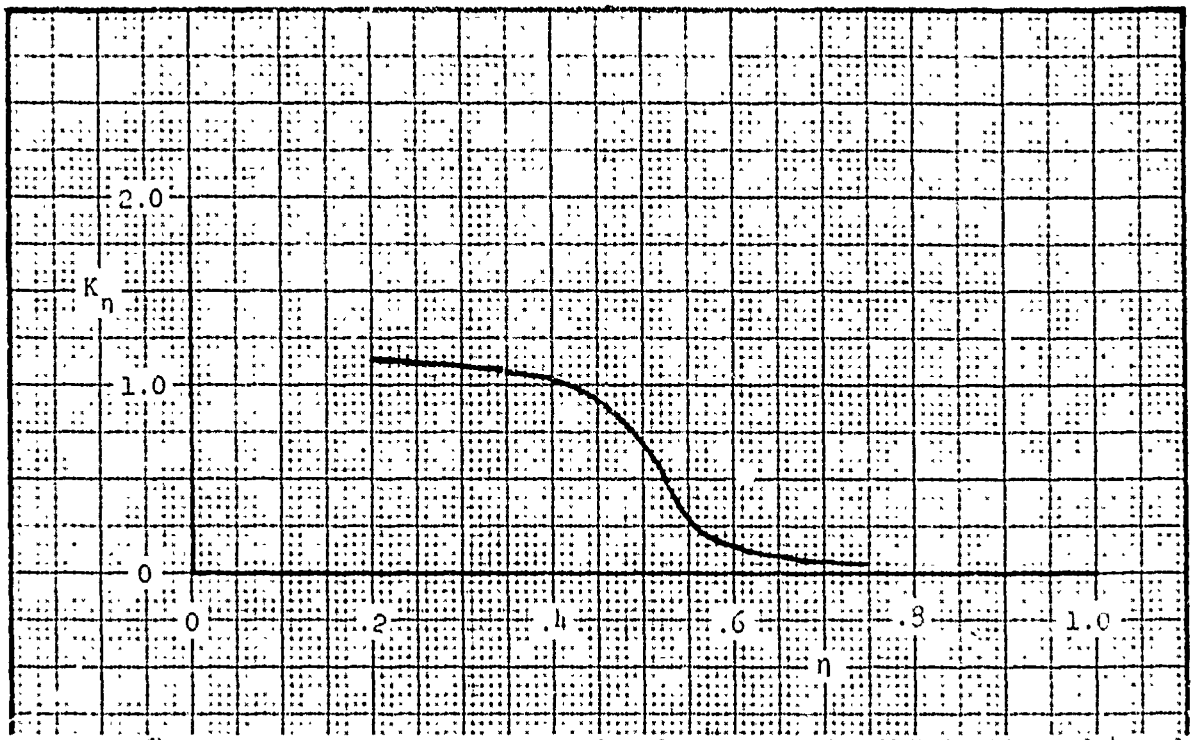


Figure 764. Axial Force Slope - Spanwise Correction for MER Stations 2,4 and 6

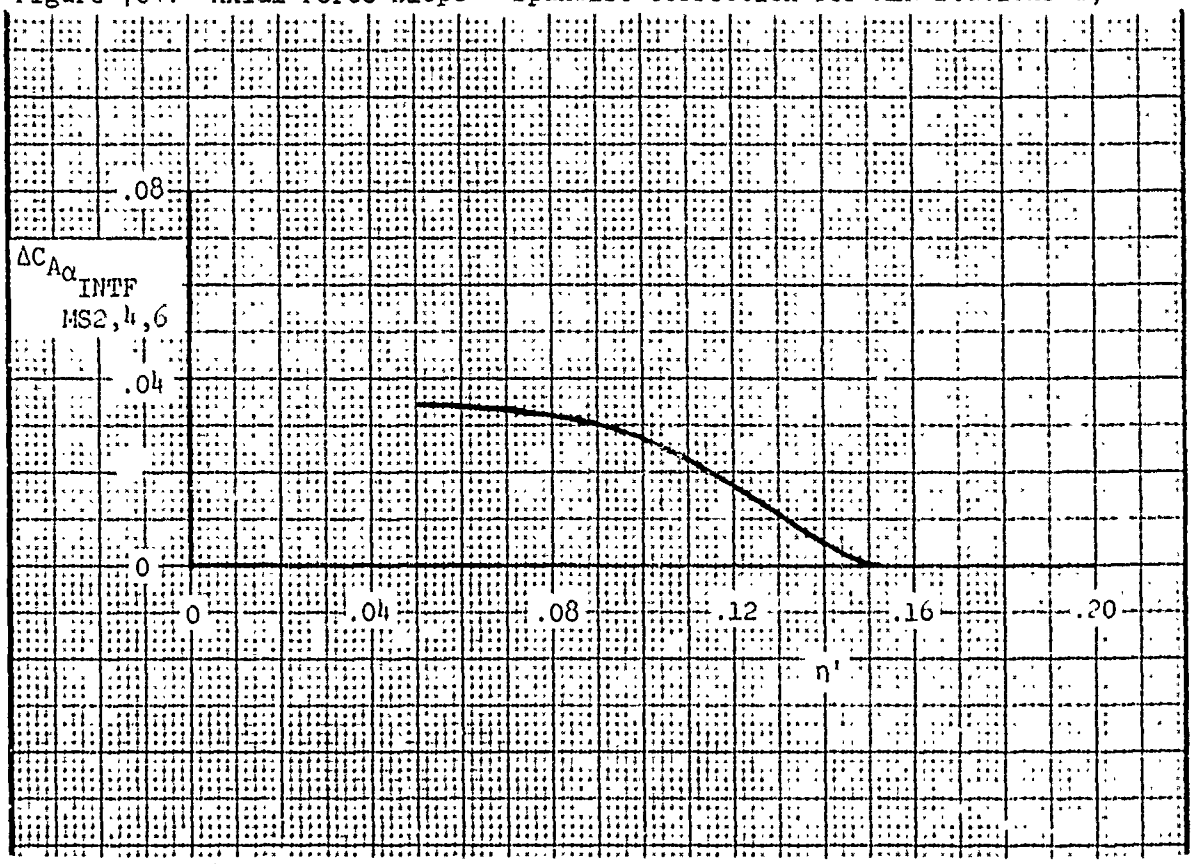


Figure 765. Axial Force Slope - Fuselage Interference Correction for MER Stations 2,4 and 6

4.5.1.2 Intercept Prediction

The axial force intercept, $\left(\frac{AF}{q}\right)_{\alpha=0}$, prediction is divided into two cases: (1) fuselage centerline-mounted and (2) wing-mounted stores for Mach numbers between 0.5 and 1.6.

FUSELAGE CENTERLINE-MOUNTED STORES

MER STATIONS 2,4 and 6 (MS2,4,6):

$$\left(\frac{AF}{q}\right)_{\substack{\alpha=0\\ MS2,4,6}} = \left(C_{A_{\alpha=0_{ISO}}} + \Delta C_{A_{\alpha=0_{\substack{INST\\ MS2,4,6}}}} + \Delta C_{A_{\alpha=0_{\substack{\mathbb{C}_M\\ MS2,4,6}}}}\right) S_{REF}$$

where:

$C_{A_{\alpha=0_{ISO}}}$ - Isolated store value of $C_{A_{\alpha=0}}$ at M = 0.5 from the method in Subsection 2.2.1.

$\Delta C_{A_{\alpha=0_{INST}}}$ - Incremental change in $C_{A_{\alpha=0_{ISO}}}$ due to installation on aircraft. Presented as a function of d_{eff}, in., where d_{eff} equals 1.732d and d is the store diameter in inches, Figure 766.

$\Delta C_{A_{\alpha=0_{\mathbb{C}_M}}}$ - Incremental change in installed $C_{A_{\alpha=0}}$ with Mach number, Figure 768.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2.

MER STATIONS 1,3, and 5 (MS1,3,5):

$$\left(\frac{AF}{q}\right)_{\substack{\alpha=0\\ MS1,3,5}} = \left(\frac{AF}{q}\right)_{\substack{\alpha=0\\ MS2,4,6}} \cdot K_{A/F_{\alpha=0}}$$

where:

$\left(\frac{AF}{q}\right)_{\substack{\alpha=0\\MS2,4,6}}$ - Value of axial force intercept obtained from preceding equation for forward cluster stores at the desired Mach number, ft^2.

$K_{A/F_{\alpha=0}}$ - Correction factor ratio of aft store intercept to forward store intercept plotted versus Mach number, Figure 769.

WING-MOUNTED STORES

MER STATIONS 2,4 and 6 (MS2,4,6):

$$\left(\frac{AF}{q}\right)_{\substack{\alpha=0\\MS2,4,6}} = \left[\left(C_{A_{\alpha=0_{ISO}}} + \Delta C_{A_{\alpha=0_{INST\ MS2,4,6}}}\right)K_\eta + \Delta C_{A_{\alpha=0_{M\ MS2,4,6}}}\right]S_{REF}$$

where:

$C_{A_{\alpha=0_{ISO}}}$ - Isolated store value of $C_{A_{\alpha=0}}$ at $M = 0.5$ obtained from Subsection 2.2.1.

$\Delta C_{A_{\alpha=0_{INST}}}$ - Incremental change in $C_{A_{\alpha=0_{ISO}}}$ due to installation on aircraft. Presented as a function of d_{eff}, in, where d_{eff} equals 1.732d, and d is the store diameter in inches, Figure 766.

K_η - Correction factor for spanwise MER location, Figure 767.

$\Delta C_{A_{\alpha=0_M}}$ - Incremental change in installed $C_{A_{\alpha=0}}$ with Mach Number, Figure 770.

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft².

MER STATIONS 1,3 and 5 (MS1,3,5):

$$\left(\frac{AF}{q}\right)_{\substack{\alpha=0 \\ MS1,3,5}} = \left(\frac{AF}{q}\right)_{\substack{\alpha=0 \\ MS2,4,6}} \cdot K_{A/F_{\alpha=0}} .$$

where:

$\left(\frac{AF}{q}\right)_{\substack{\alpha=0 \\ MS2,4,6}}$ - Value of axial force intercept obtained from preceding equation for forward cluster stores at the desired Mach number, ft².

$K_{A/F_{\alpha=0}}$ - Correction factor ratio of aft store intercept to forward store intercept plotted versus Mach number, Figure 769.

Example:

Calculate $\left(\frac{AF}{q}\right)_{\alpha=0}$ for an M117 on MER Station 6 of a fully loaded MER on A-7 center pylon at M = 0.7.

Required for Computation:

$S_{REF} = 1.42$ ft²

$\eta = .418$

$d_{eff} = 27.3$ in.

$C_{A_{\alpha=0_{ISO}}}$ = .0591 Subsection 2.2.1.

$\Delta C_{A_{\alpha=0_{INST\ MS6}}}$ = .180 - Figure 766

$K_\eta = 1.0$ - Figure 767

$$\Delta C_{A_{\substack{\alpha=0\\M\\MS6}}} = 0.0 - \text{Figure 770}$$

Substituting,

$$\left(\frac{AF}{q}\right)_{\substack{\alpha=0\\MS6}} = [(.0591 + .180)1.0 + 0.0]1.42 = .339 \text{ ft}^2$$

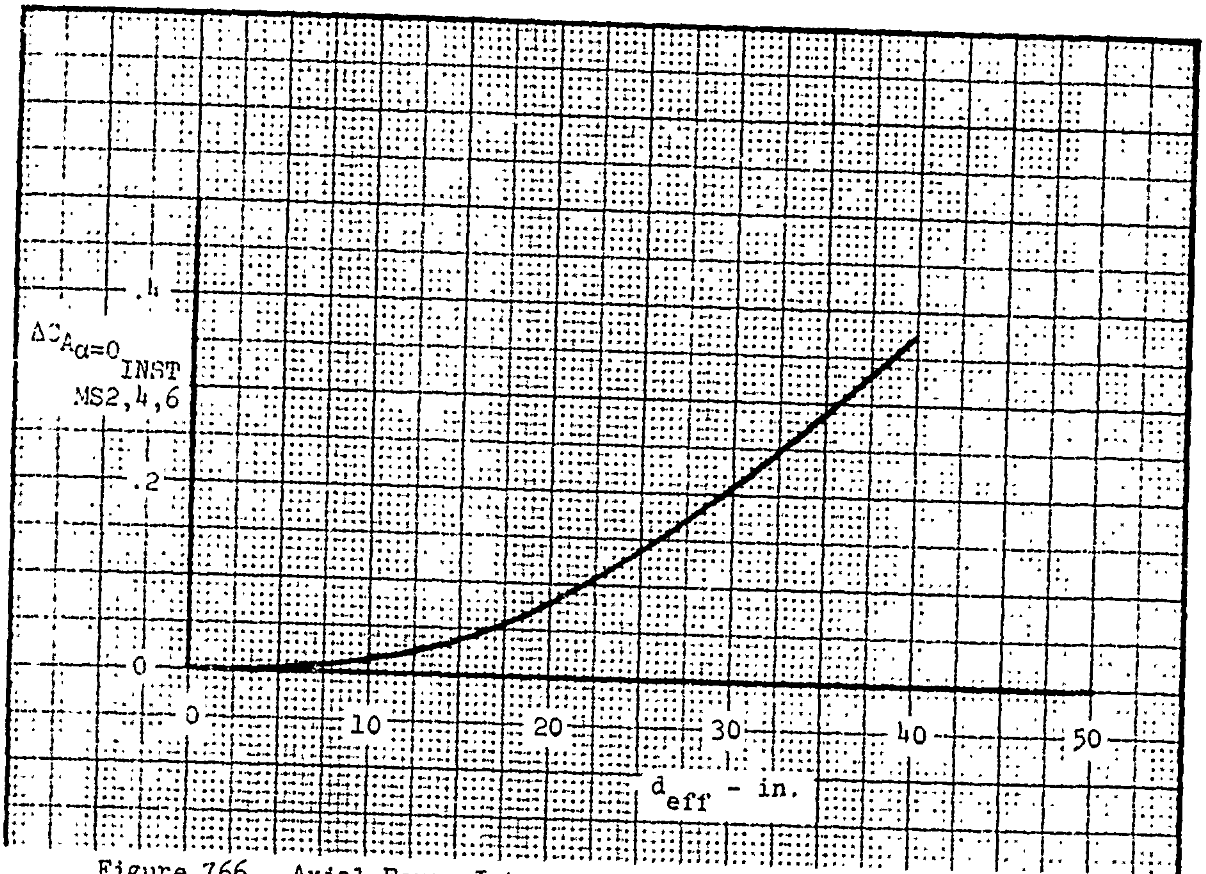


Figure 766. Axial Force Intercept - Installed Coefficient for MER Stations 2, 4 and 6

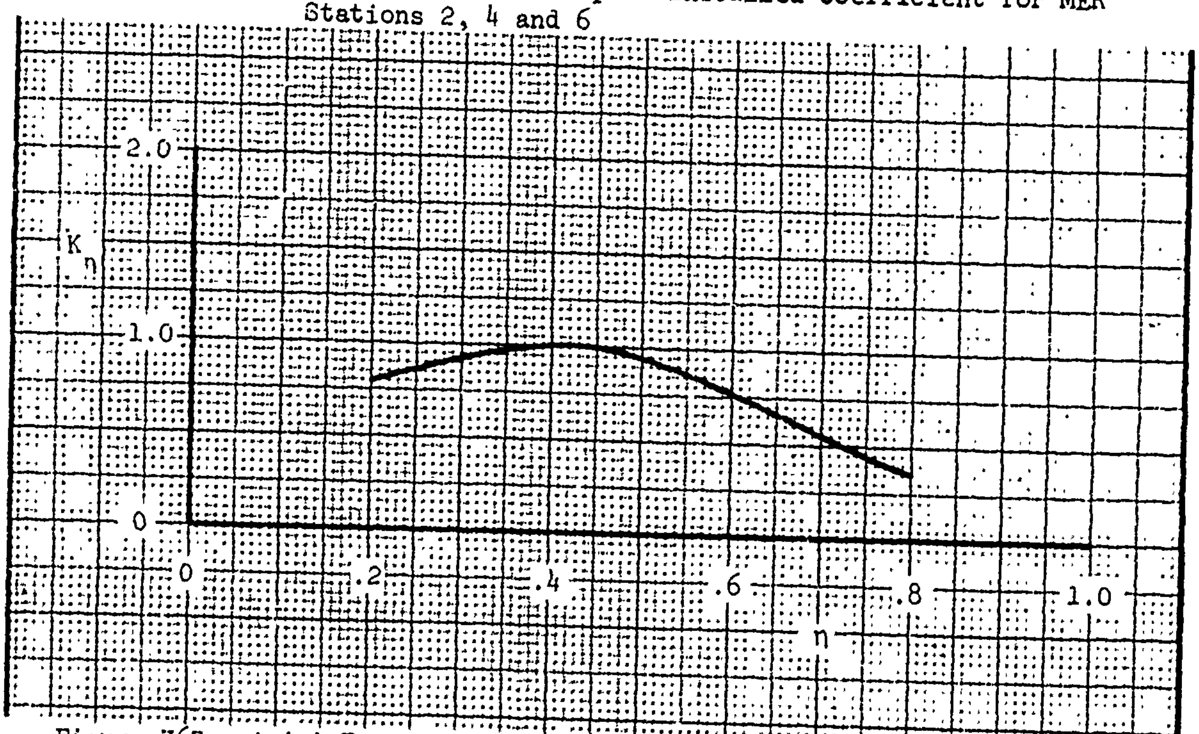


Figure 767. Axial Force Intercept - Spanwise Correction for MER Stations 2, 4 and 6

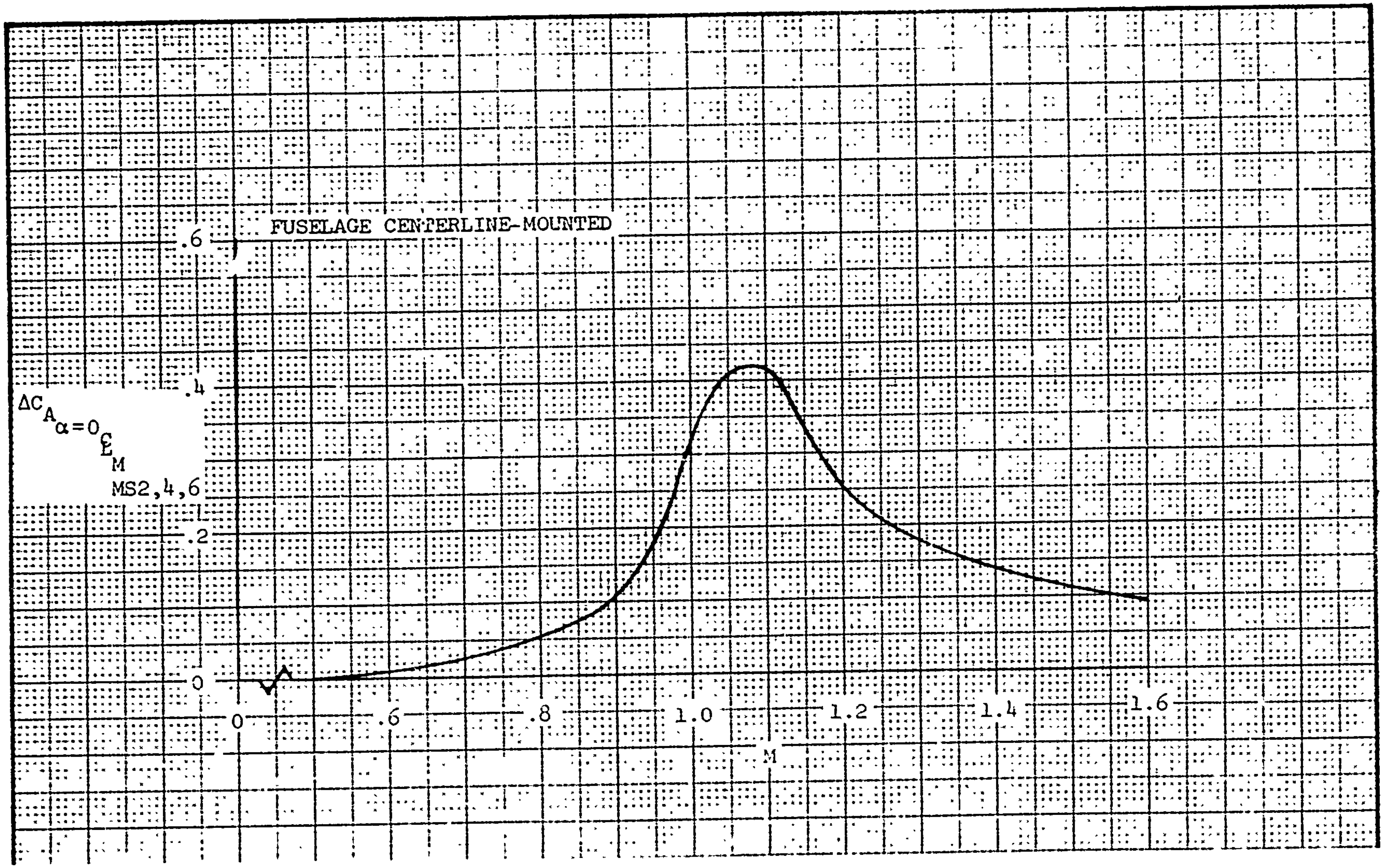


Figure 768. Axial Force Intercept - Mach Number Correction for MER Stations 2, 4 and 6 on Fuselage Centerline

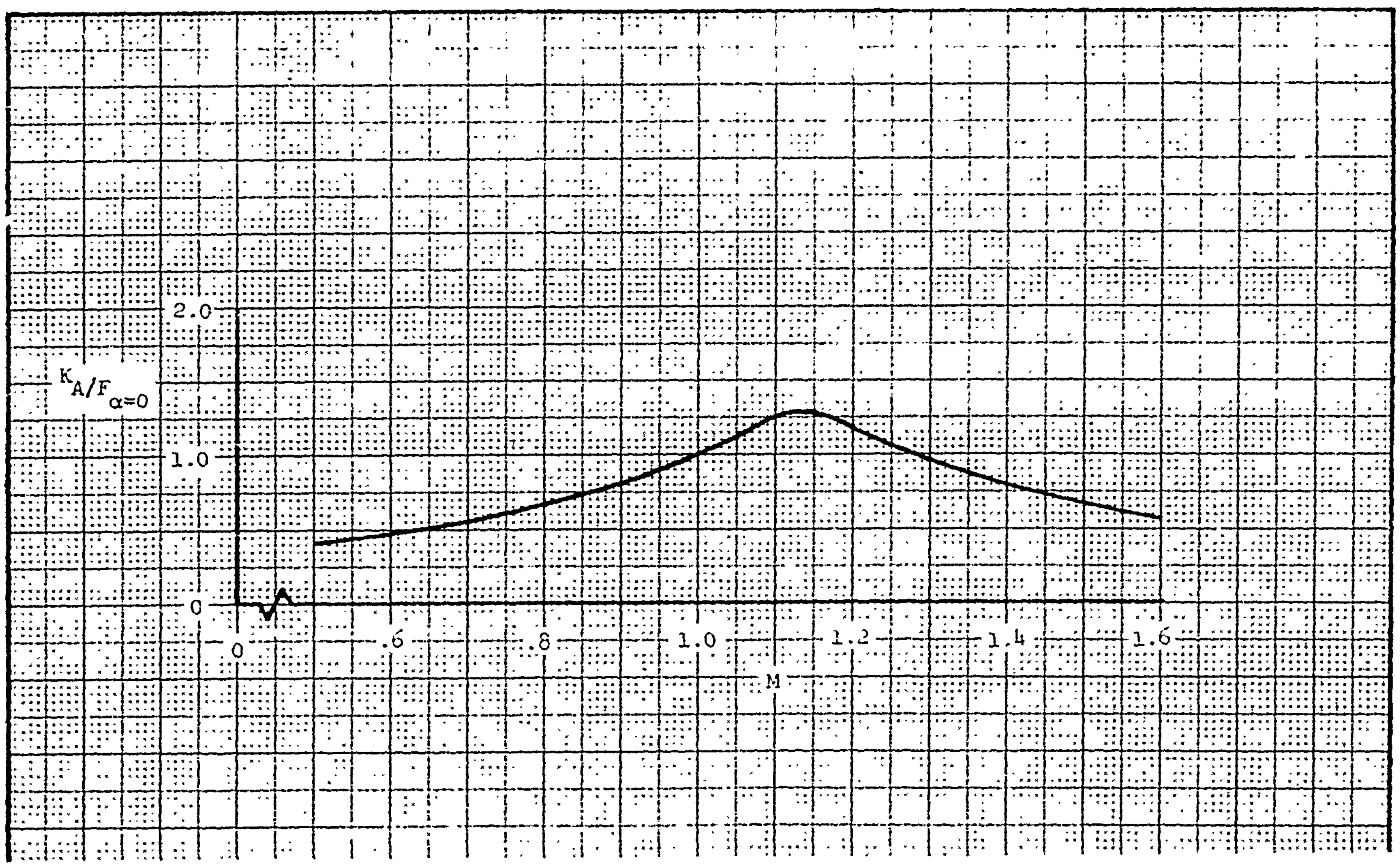


Figure 769. Axial Force Intercept - Aft Cluster Correction

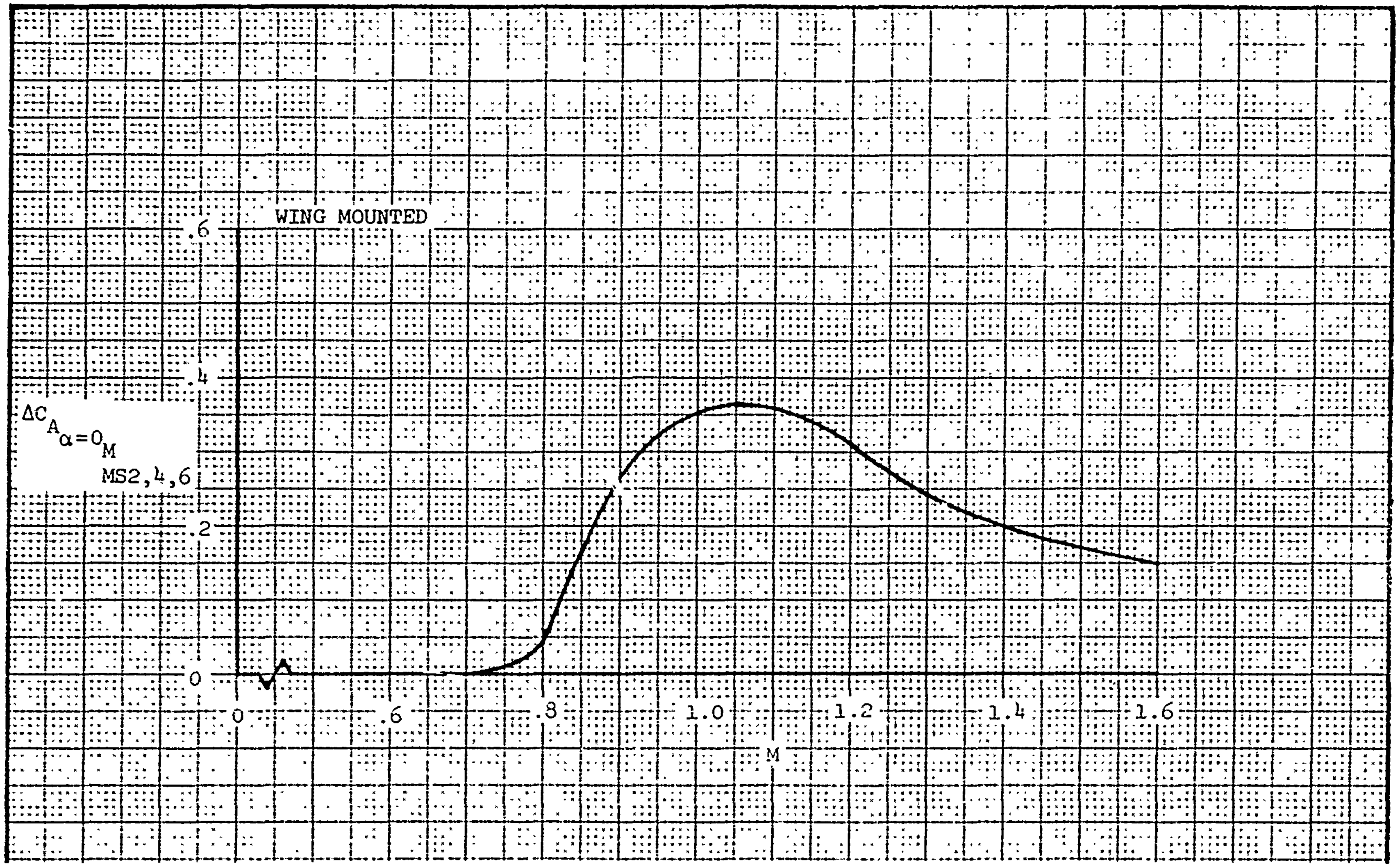


Figure 770. Axial Force Intercept - Mach Number Correction for MER Stations 2, 4 and 6 for Wing-Mounted Stores

4.5.2 Increment-Aircraft Yaw

The incremental axial force due to aircraft yaw for multiple carriage stores is negligible. Therefore, no prediction equations are included with this subsection.

4.5.3 Increment-Adjacent Store Interference

The incremental axial force due to adjacent store interference for multiple carriage stores is negligible. Therefore, no prediction equations are included with this subsection.

4.6 ROLLING MOMENT

4.6.1 Basic Airload

The basic airload equations for multiple store carriage rolling moment slope and intercept are presented and derived in a manner similar to the single store case.

4.6.1.1 Slope Prediction

The equations to predict rolling moment slope at M = 0.5 are divided into two cases: (1) fuselage centerline-mounted and (2) wing-mounted stores.

FUSELAGE CENTERLINE-MOUNTED STORES

MER STATIONS 1 and 2 (MS1,2):

$\left(\frac{RM}{q}\right)_{\alpha_{MS1,2}}$ is zero by reasons of symmetry.

MER STATIONS 3 and 4 (MS3,4):

$$\left(\frac{RM}{q}\right)_{\alpha_{MS3,4}} = K_{SLOPE_{\mathfrak{L}_{MS3,4}}} \cdot \text{FIN AREA}$$

where:

$K_{SLOPE_{\mathfrak{L}}}$ - Variation of rolling moment slope with FIN AREA, $\frac{ft}{deg}$, $K_{SLOPE_{\mathfrak{L}_{MS3}}} = -.0013$ and $K_{SLOPE_{\mathfrak{L}_{MS4}}} = .0054$

FIN AREA - Total planform area of all store fins, ft^2.

MER STATIONS 5 and 6 (MS5,6):

$$\left(\frac{RM}{q}\right)_{\alpha_{\substack{MS5\\MS6}}} = -\left(\frac{RM}{q}\right)_{\alpha_{\substack{MS3\\MS4}}}$$

where:

$\left(\frac{RM}{q}\right)_{\alpha_{\substack{MS3\\MS4}}}$ - Value of rolling moment slope obtained from preceding equation, $\frac{ft^3}{deg}$

WING-MOUNTED STORES

MER STATIONS 1,2,3 and 5 (MS1,2,3,5):

$$\left(\frac{RM}{q}\right)_{\alpha_{MS1,2,3,5}} = K_{SLOPE_{1_{MS1,2,3,5}}} \cdot \text{FIN AREA}$$

where:

K_{SLOPE_1} - Variation of rolling moment slope with FIN AREA, $\frac{ft.}{deg.}$.

MER STA 1 - Figure 771

MER STA 2 - Figure 771

MER STA 3 - Figure 772

MER STA 5 - Figure 772

FIN AREA- Total planform area of all store fins, ft^2.

MER STATIONS 4 and 6 (MS4,6):

$$\left(\frac{RM}{q}\right)_{\alpha_{MS4,6}} = (K_{SLOPE_{1_{MS4,6}}} + \Delta K_{SLOPE_{\substack{INTF\\MS4,6}}})\text{FIN AREA}$$

where:

K_{SLOPE_1} - Variation of rolling moment slope with FIN AREA, $\frac{ft}{deg}$,

MER STA 4 - Figure 773

MER STA 6 - Figure 773

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high-wing aircraft, $\frac{ft}{deg}$.

MER STA 4 - Figure 774

MER STA 6 - Figure 774

FIN AREA - Total planform area of all store fins, ft^2.

Example:

Calculate $\left(\frac{RM}{q}\right)_\alpha$ for an M117 on MER Station 6 of a fully loaded MER on A-7 center pylon at M = 0.5.

Required for Computation:

FIN AREA = 4.99 ft^2.

$\eta' = .353$

$K_{SLOPE_{1_{MS6}}} = -.0078$, Figure 773

$\Delta K_{SLOPE_{INTF_{MS6}}} = 0.0$, Figure 774

Substituting,

$$\left(\frac{RM}{q}\right)_{\alpha_{MS6}} = (-.0078 + 0.0)4.99 = .0389 \frac{ft^3}{deg}$$

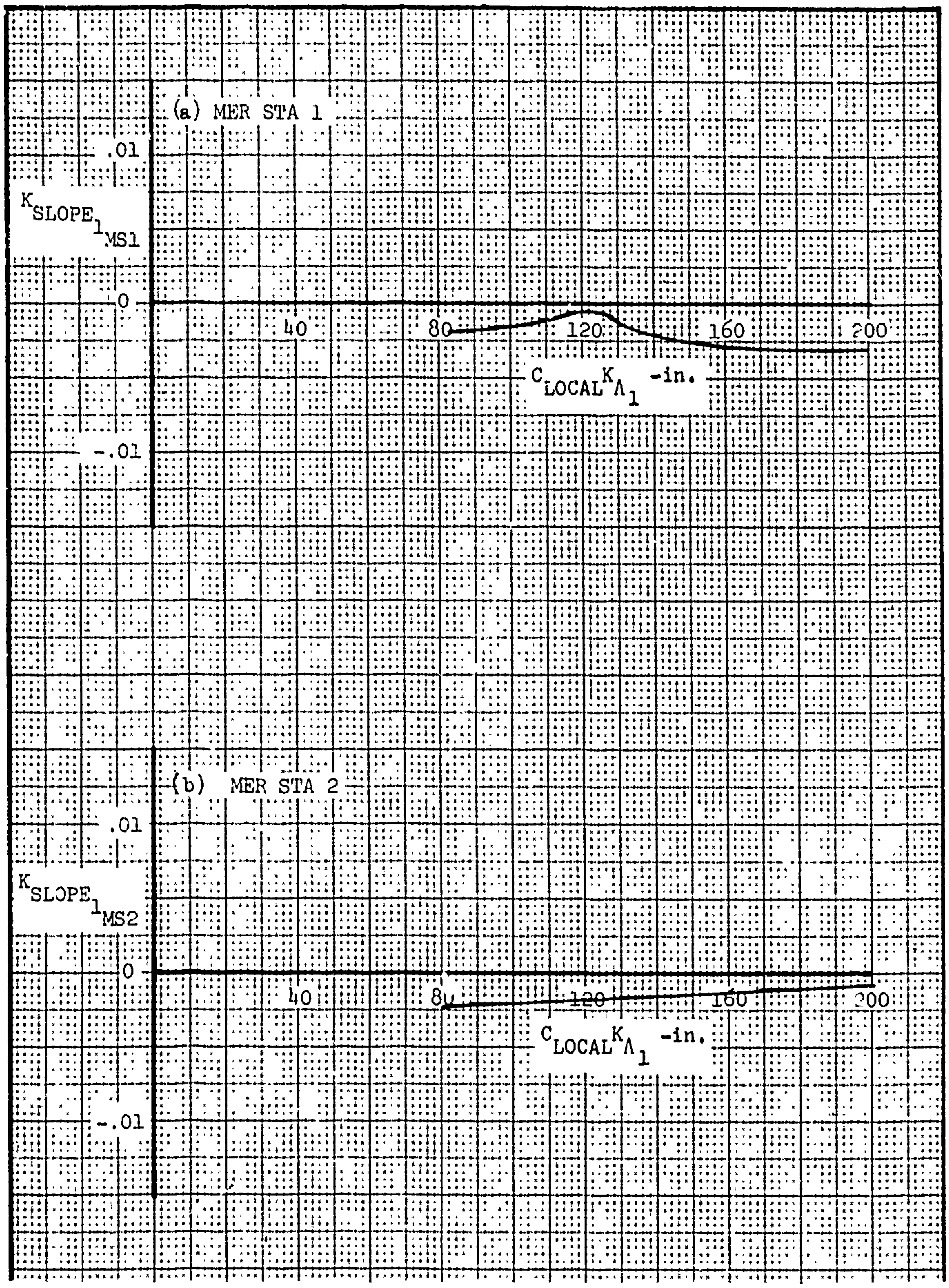


Figure 771. Rolling Moment Slope - Variation with Fin Area for MER Stations 1 and 2

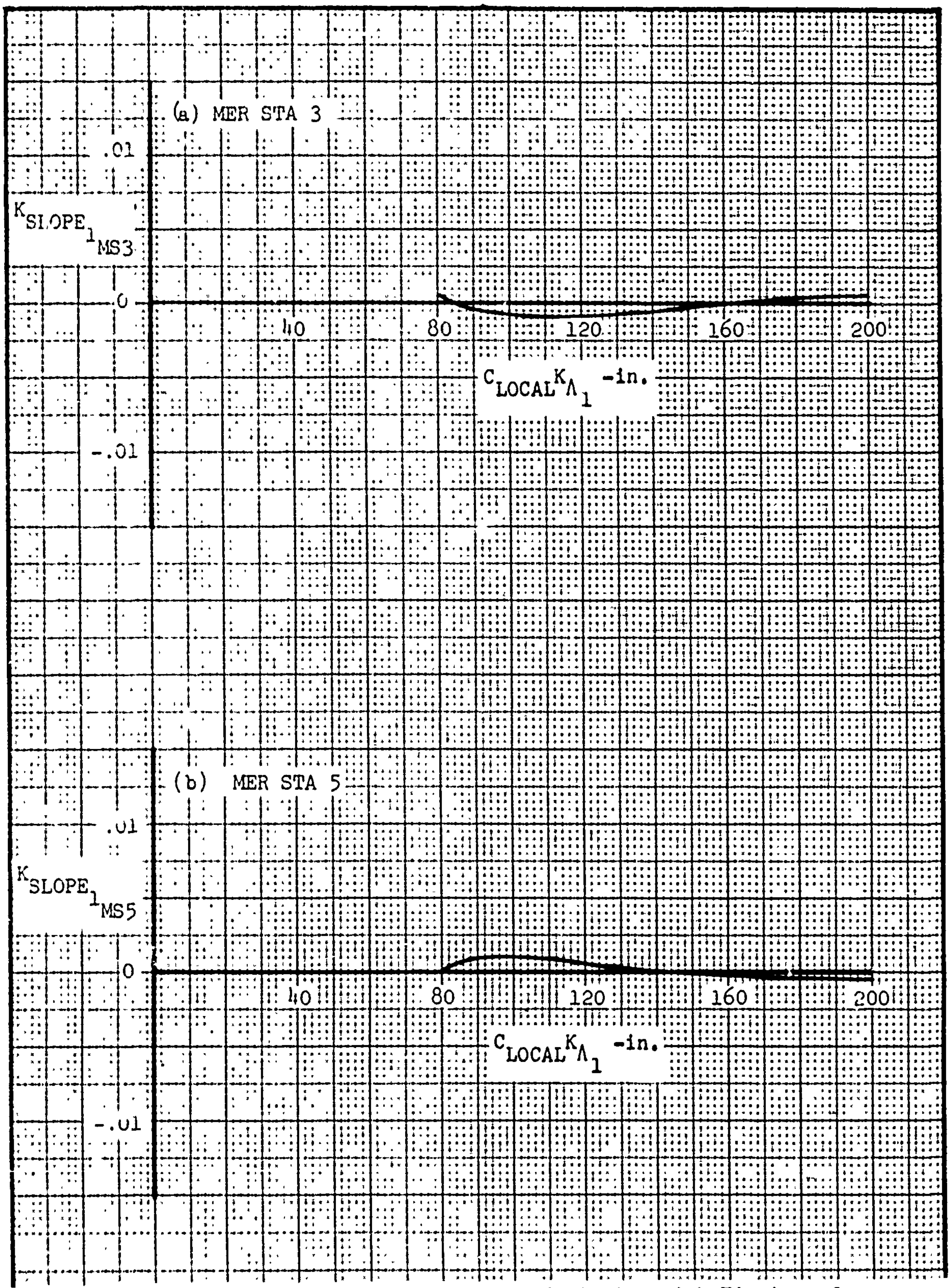


Figure 772. Rolling Moment Slope - Variation with Fin Area for MER Stations 3 and 5

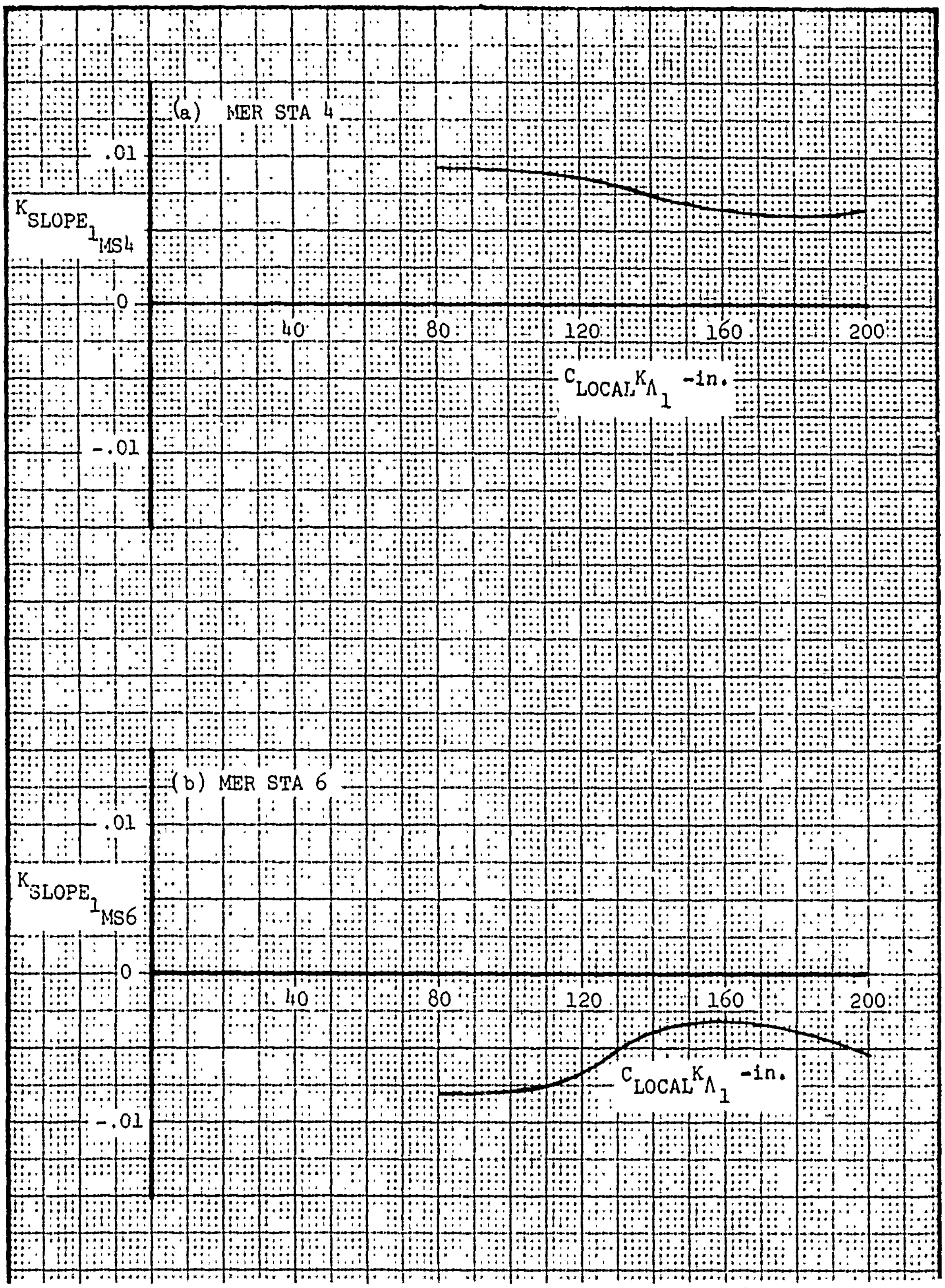


Figure 773. Rolling Moment Slope - Variation with Fin Area for MER Stations 4 and 6

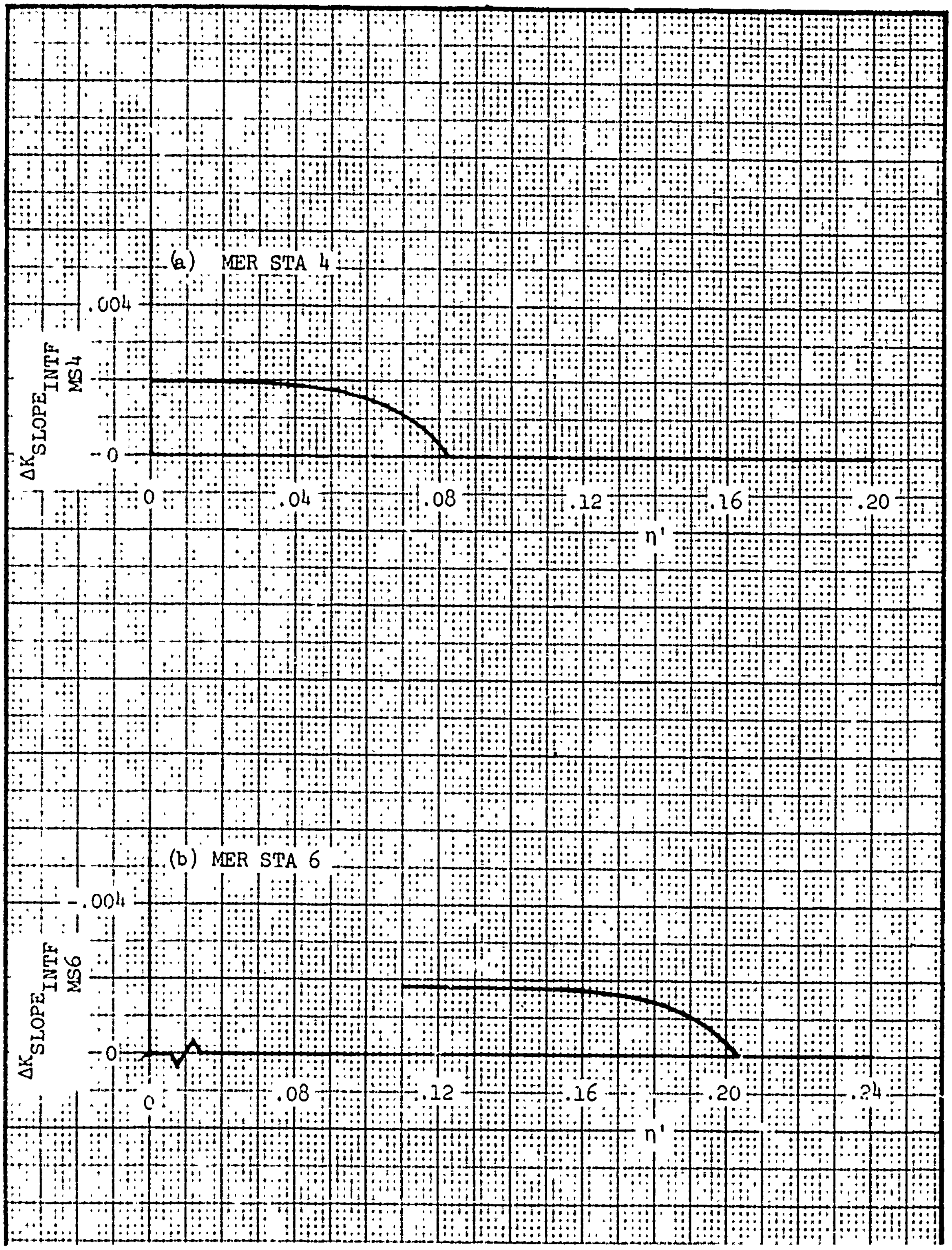


Figure 774. Rolling Moment Slope - Fuselage Interference Correction for MER Stations 4 and 6

4.6.1.2 Slope Mach Number Correction

The equation to predict rolling moment slope between M = 0.5 and M = 1.6 is as follows.

$$\left(\frac{RM}{q}\right)_{\alpha_{M=x}} = \left(\frac{RM}{q}\right)_{\alpha_{M=0.5}} + \Delta\left(\frac{RM}{q}\right)_{\alpha_{M=x}}$$

where:

$\left(\frac{RM}{q}\right)_{\alpha_{M=0.5}}$ - Value of rolling moment slope at M = 0.5 from Subsection 4.6.1.1, $\frac{ft^3}{deg}$.

$\Delta\left(\frac{RM}{q}\right)_{\alpha_{M=x}}$ - Incremental change in rolling moment slope with Mach number from the value predicted at M = 0.5 $\frac{ft^3}{deg}$

As in the preceding section, the incremental change with Mach number prediction has been divided into cases of fuselage centerline mounted and wing mounted stores.

FUSELAGE CENTERLINE-MOUNTED STORES

MER STATIONS 1 and 2 (MS1,2):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha} = 0 \text{ by symmetry}$$

MER STATIONS 3 and 4 (MS3,4):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{MS3,4}} = \Delta K_{SLOPE_{1_{MS3,4}}} \cdot \text{FIN AREA}$$

where:

ΔK_{SLOPE_1} - Variation of incremental rolling moment slope with FIN AREA, $\frac{ft}{deg}$.

MER STA 3 - Figure 776

MER STA 4 - Figure 777

FIN AREA - Total plan form area of all store fins, ft^2.

MER STATIONS 5 and 6 (MS5,6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{\substack{MS5\\MS6}}} = -\Delta\left(\frac{RM}{q}\right)_{\alpha_{\substack{MS3\\MS4}}}$$

where:

$\Delta\left(\frac{RM}{q}\right)_{\alpha_{\substack{MS3\\MS4}}}$ - Value of rolling moment slope obtained from MS3,4 computation above.

WING-MOUNTED STORES

A generalized curve of rolling moment slope variation with Mach number is shown in Figure 775.

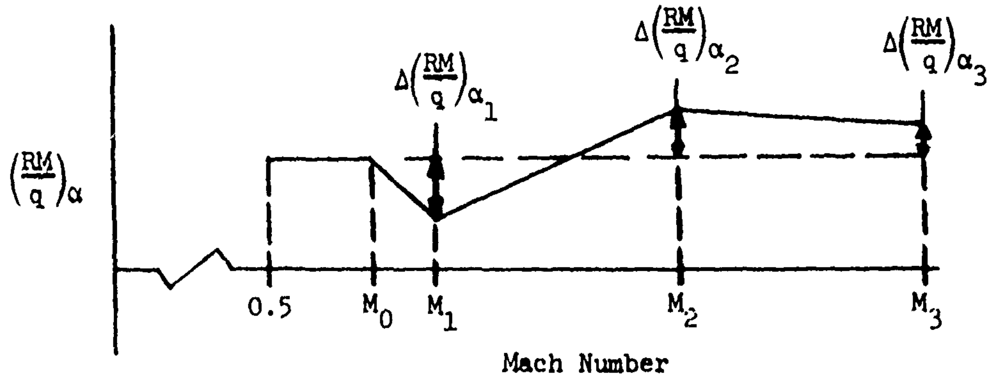


Figure 775. Rolling Moment Slope - Generalized Mach Number Variation

The rolling moment variation with Mach number has been approximated by a series of linear segments with breaks occurring at Mach numbers designated by M_0, M_1, M_2 and M_3 for each of the six

MER Stations. These Mach break points are presented as a function of $C_{LOCAL}K_{\Lambda_1}$ in Figure 778 (MS1,2), Figure 779 (MS3,5) and Figure 780 (MS4,6). M_0 is the Mach number where the slope initially deviates from the value predicted at M = 0.5. Equations have been developed to predict the deltas (incremental) slope changes from the value at M = 0.5 for each of the remaining Mach break points. These equations are presented below.

Break 1 (M_1):

MER STATIONS 1,2,4, and 6 (MS1,2,4,6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{1}\,MS1,2,4,6} = \left(K_{SLOPE_{1}\,MS1,2,4,6} + \Delta K_{SLOPE_{1}\,INTF\,MS1,2,4,6}\right) \text{FIN AREA}$$

where:

K_{SLOPE_1} - Variation of incremental rolling moment slope with FIN AREA, $\frac{ft}{deg}$.

MER STA 1 - Figure 781

MER STA 2 - Figure 781

MER STA 4 - Figure 784

MER STA 6 - Figure 784

$\Delta K_{SLOPE_{1}\,INTF}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high-wing aircraft, $\frac{ft}{deg}$.

MER STA 1 - Figure 782

MER STA 2 - Figure 782

MER STA 4 - Figure 785

MER STA 6 - Figure 785

FIN AREA - Total planform area of all store fins, ft^2.

MER STATIONS 3 and 5 (MS3,5):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{1}\,MS3,5} = K_{SLOPE_{1}\,MS3,5} \cdot \text{FIN AREA}$$

where:

K_{SLOPE_1} - Variation of incremental rolling moment slope with FIN AREA, $\frac{ft}{deg}$,

MER STA 3 - Figure 783

MER STA 5 - Figure 783

FIN AREA - Total planform area of all store fins, ft^2.

BREAK 2 (M_2):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{2_{MS1-6}}} = \left(K_{SLOPE_{2_{MS1-6}}} + \Delta K_{SLOPE_{2_{INTF_{MS1-6}}}}\right) \text{FIN AREA}$$

where:

K_{SLOPE_2} - Variation of incremental rolling moment slope with FIN AREA, $\frac{ft}{deg}$.

MER STA 1 - Figure 786

MER STA 2 - Figure 786

MER STA 3 - Figure 788

MER STA 4 - Figure 790

MER STA 5 - Figure 788

MER STA 6 - Figure 790

$\Delta K_{SLOPE_{2_{INTF}}}$ - Incremental change in K_{SLOPE_2} due to interference effect of the fuselage for high-wing aircraft, $\frac{ft}{deg.}$.

MER STA 1 - Figure 787

MER STA 2 - Figure 787

MER STA 3 - Figure 789

MER STA 4 - Figure 791

MER STA 5 - Figure 789

MER STA 6 - Figure 791

FIN AREA - Total planform area of all store fins, ft^2.

BREAK 3 (M_3):

MER STATIONS 2 and 3 (MS2,3):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{3_{MS2,3}}} = K_{SLOPE_{3_{MS2,3}}} \cdot \text{FIN AREA}$$

where:

K_{SLOPE_3} - Variation of incremental rolling moment slope with FIN AREA, $\frac{ft}{deg}$.

MER STA 2 - Figure 792

MER STA 3 - Figure 792

FIN AREA - Total planform area of all store fins, ft^2.

MER STATIONS 4 and 6 (MS4,6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{3_{MS4,6}}} = \left(K_{SLOPE_{3_{MS4,6}}} + \Delta K_{SLOPE_{3_{INTF_{MS4,6}}}}\right)\text{FIN AREA}$$

where:

K_{SLOPE_3} - Variation of incremental rolling moment slope with FIN AREA, $\frac{ft}{deg}$.

MER STA 4 - Figure 793

MER STA 6 - Figure 793

$\Delta K_{SLOPE_{3_{INTF}}}$ - Incremental change in K_{SLOPE_3} due to interference effect of the fuselage for high-wing aircraft, $\frac{ft}{deg}$.

MER STA 4 - Figure 794

MER STA 6 - Figure 794

FIN AREA - Total planform area of all store fins, ft^2.

To compute $\left(\frac{RM}{q}\right)_\alpha$ at M = x, first determine from Figures 778-780 between which Mach break points M = x occurs using the appropriate MER Station curve. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break point. Then, compute $\left(\frac{RM}{q}\right)_\alpha$ at M = x from the following expression.

$$\left(\frac{RM}{q}\right)_{\alpha_{M=x}} = \left(\frac{RM}{q}\right)_{\alpha_{M=0.5}} + \Delta\left(\frac{RM}{q}\right)_{\alpha_{M_{LOW}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right) \left[\Delta\left(\frac{RM}{q}\right)_{\alpha_{M_{HI}}} - \Delta\left(\frac{RM}{q}\right)_{\alpha_{M_{LOW}}} \right]$$

If $x \le M_C$, then $\left(\frac{RM}{q}\right)_\alpha$ at M = x is equal to the value of Subsection 4.6.1.1 (the initial term of the above equation).

A numerical example illustrating the use of the above equation is found in Subsection 4.1.1.2.

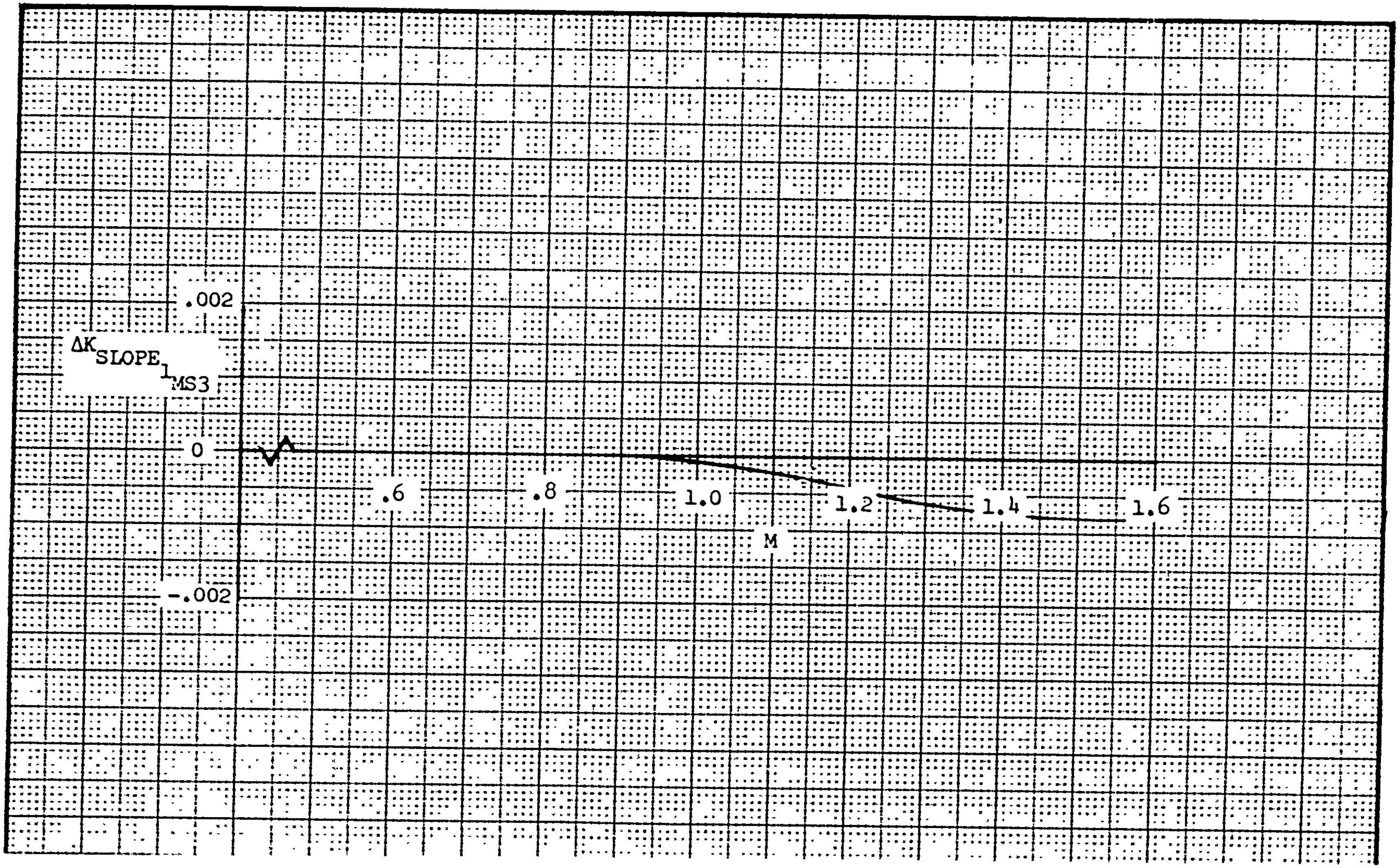


Figure 776. Rolling Moment Slope - Incremental Variation with Fin Area for MER Station 3

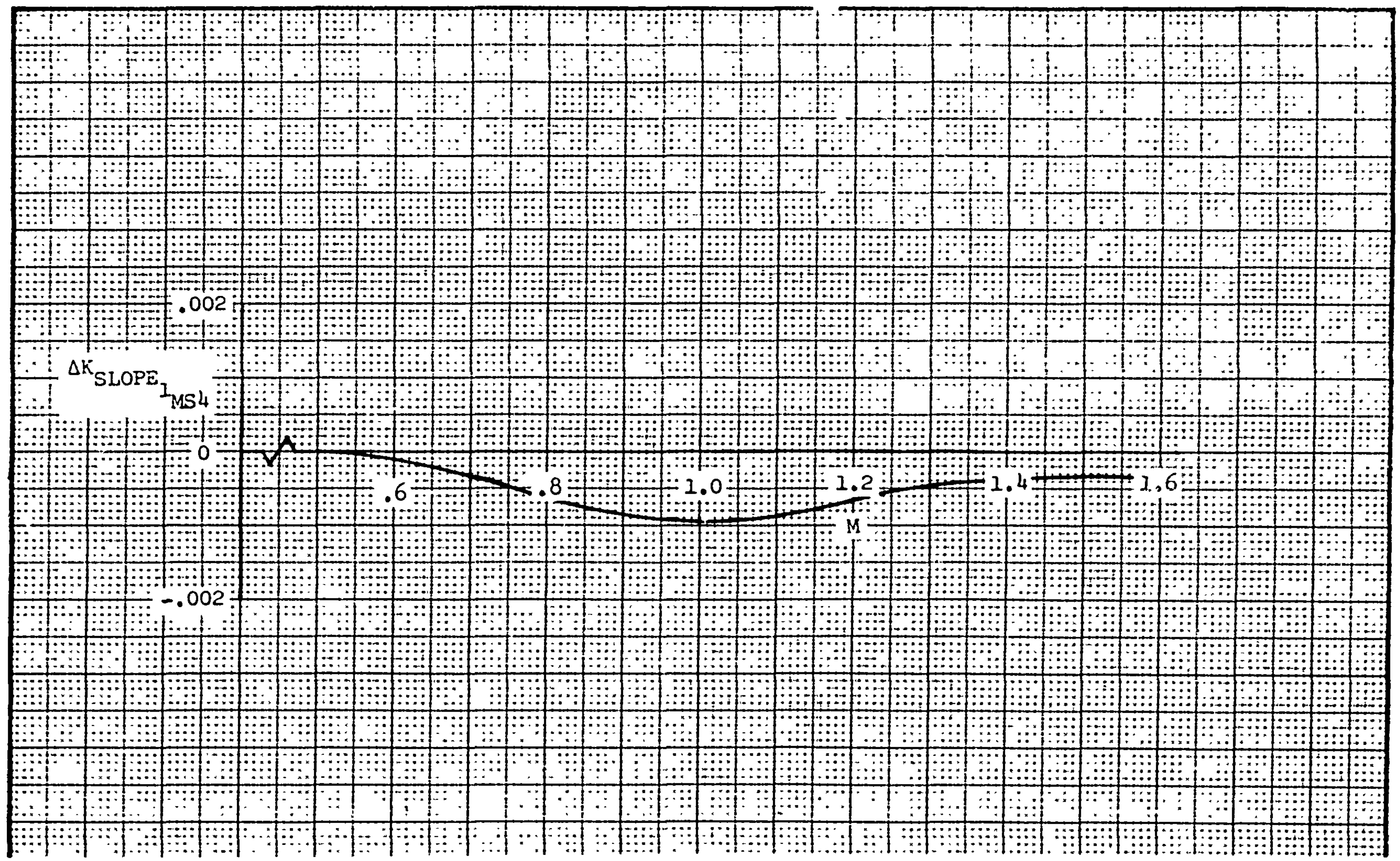


Figure 777. Rolling Moment Slope - Incremental Variation with Fin Area for MER Station 4

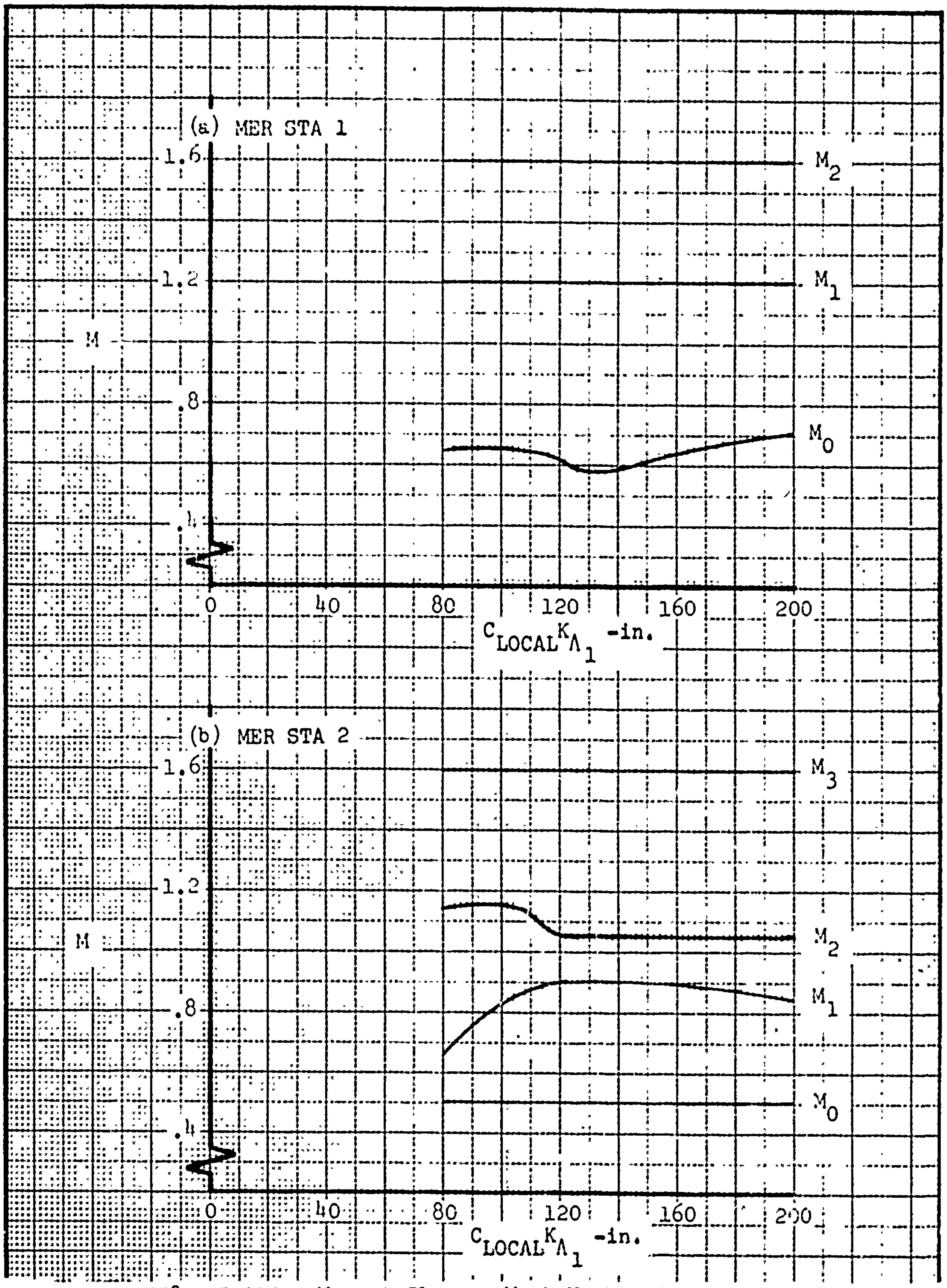


Figure 778. Rolling Moment Slope - Mach Number Break Points for MER Stations 1 and 2

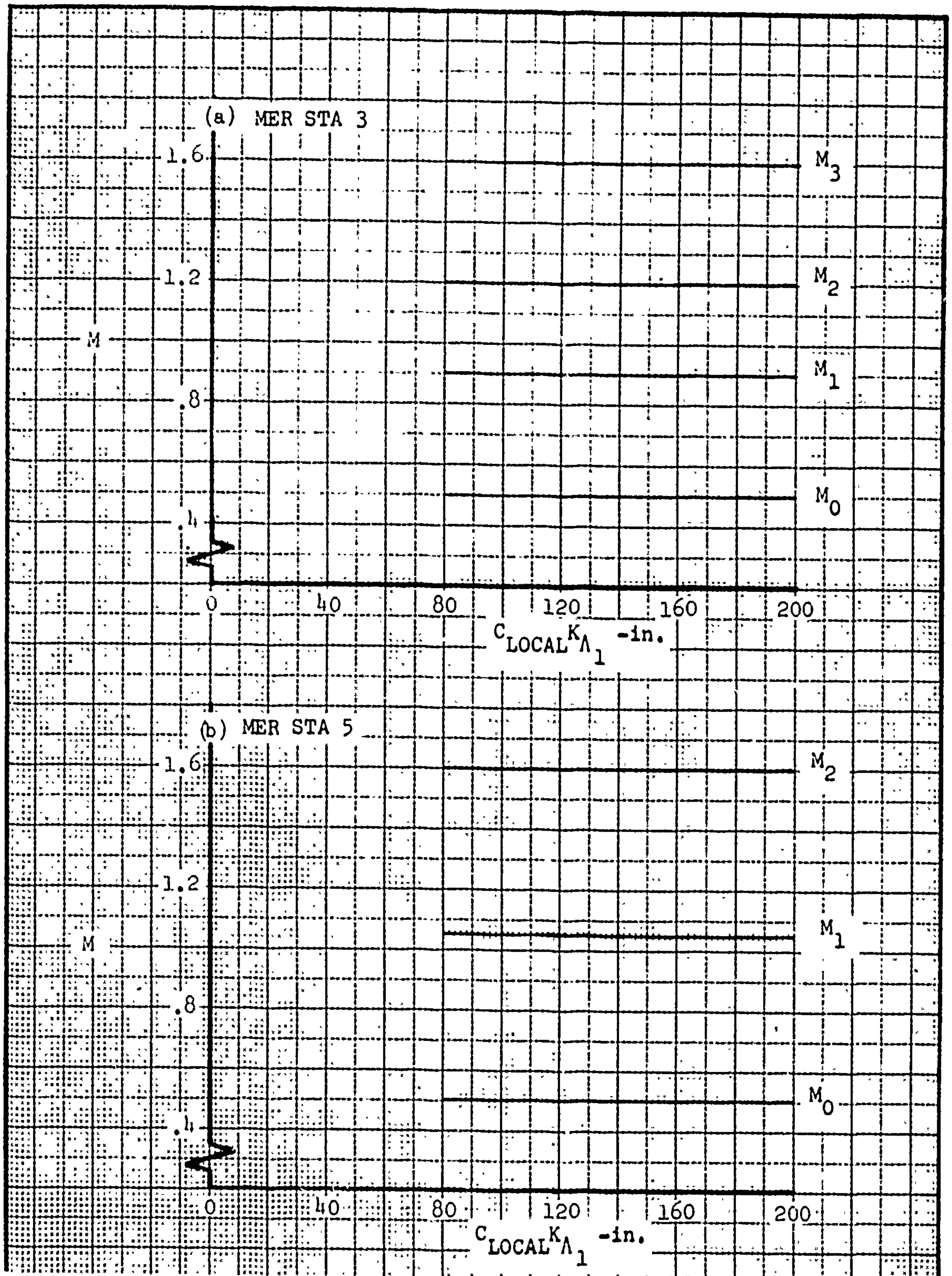


Figure 779. Rolling Moment Slope - Mach Number Break Points for MER Stations 3 and 5

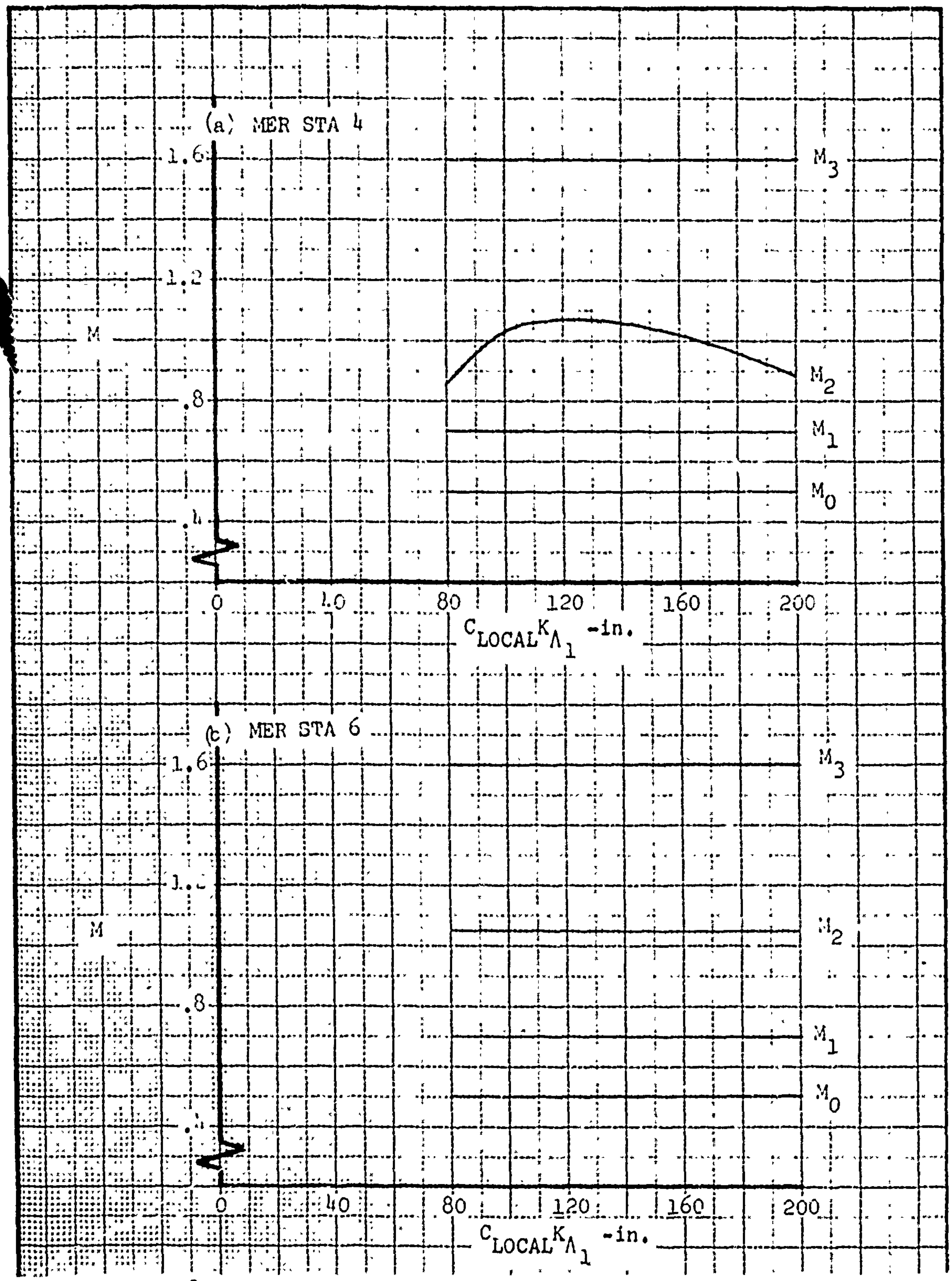


Figure 780. Rolling Moment Slope - Mach Number Break Points for MER Stations 4 and 6

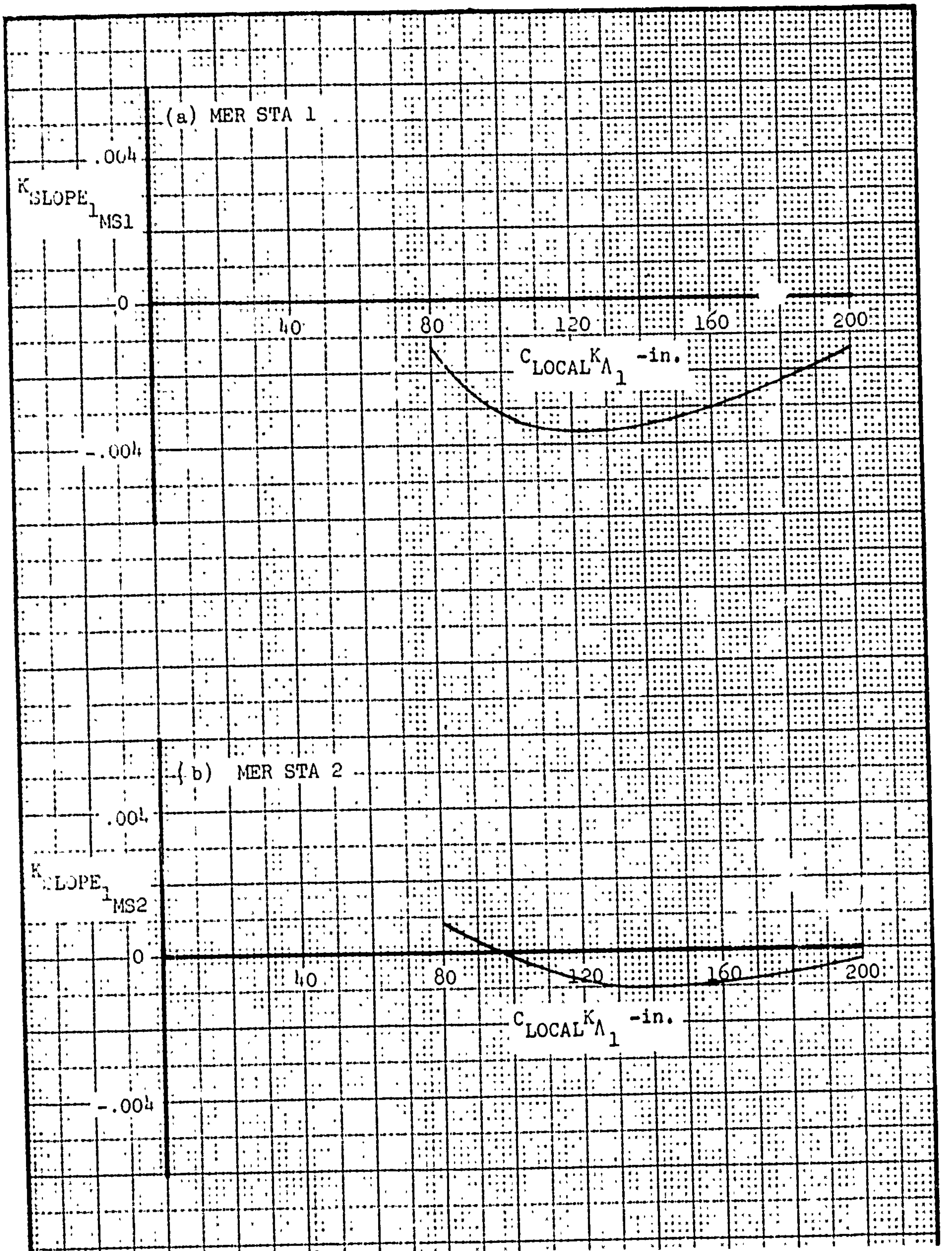


Figure 781. Rolling Moment Slope - K_{SLOPE_1} for MER Stations 1 and 2

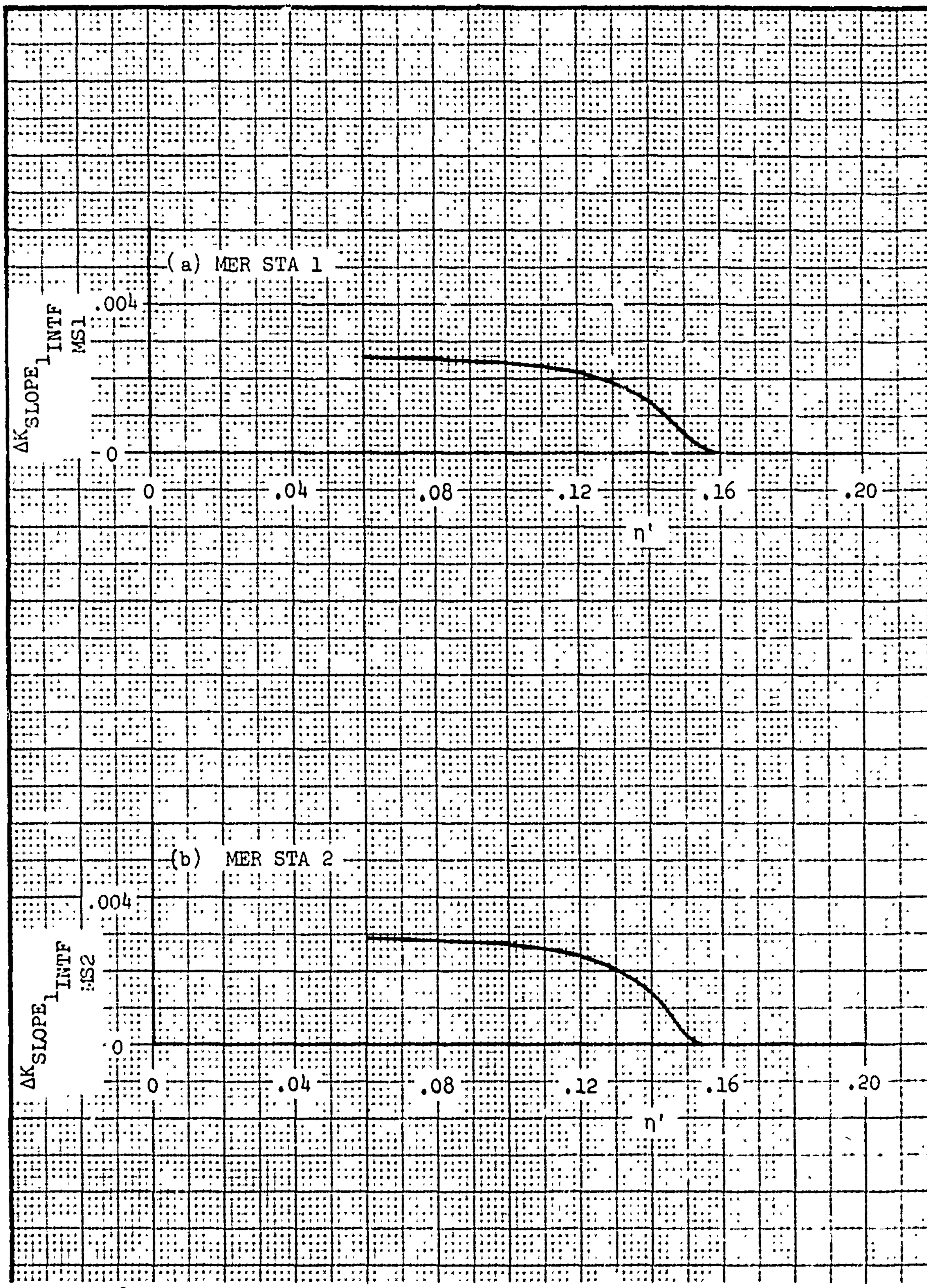


Figure 782. Rolling Moment Slope - K_{SLOPE_1} Fuselage Interference Correction for MER Stations 1 and 2

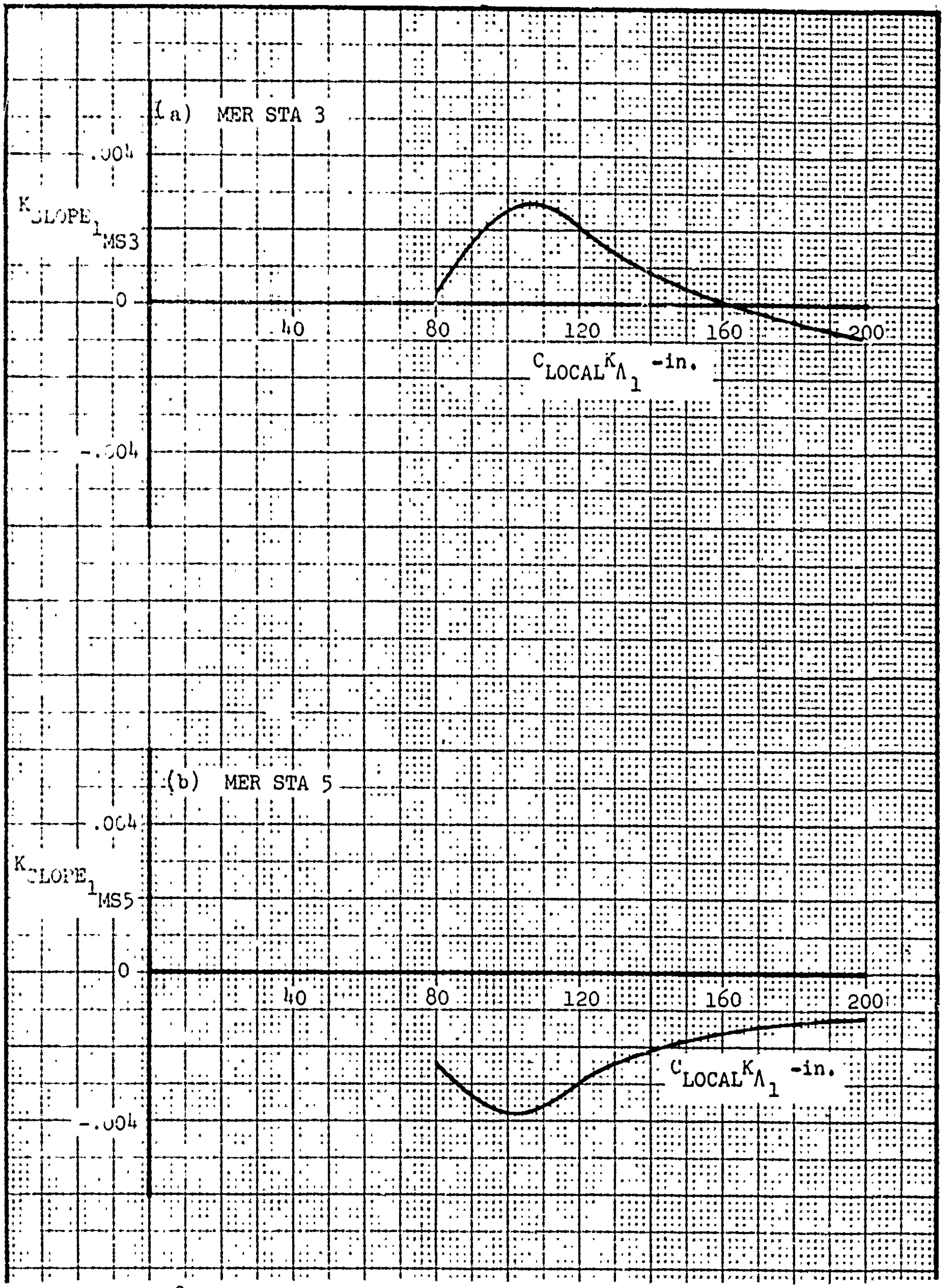


Figure 783. Rolling Moment Slope - K_{SLOPE_1} for MER Stations 3and 5

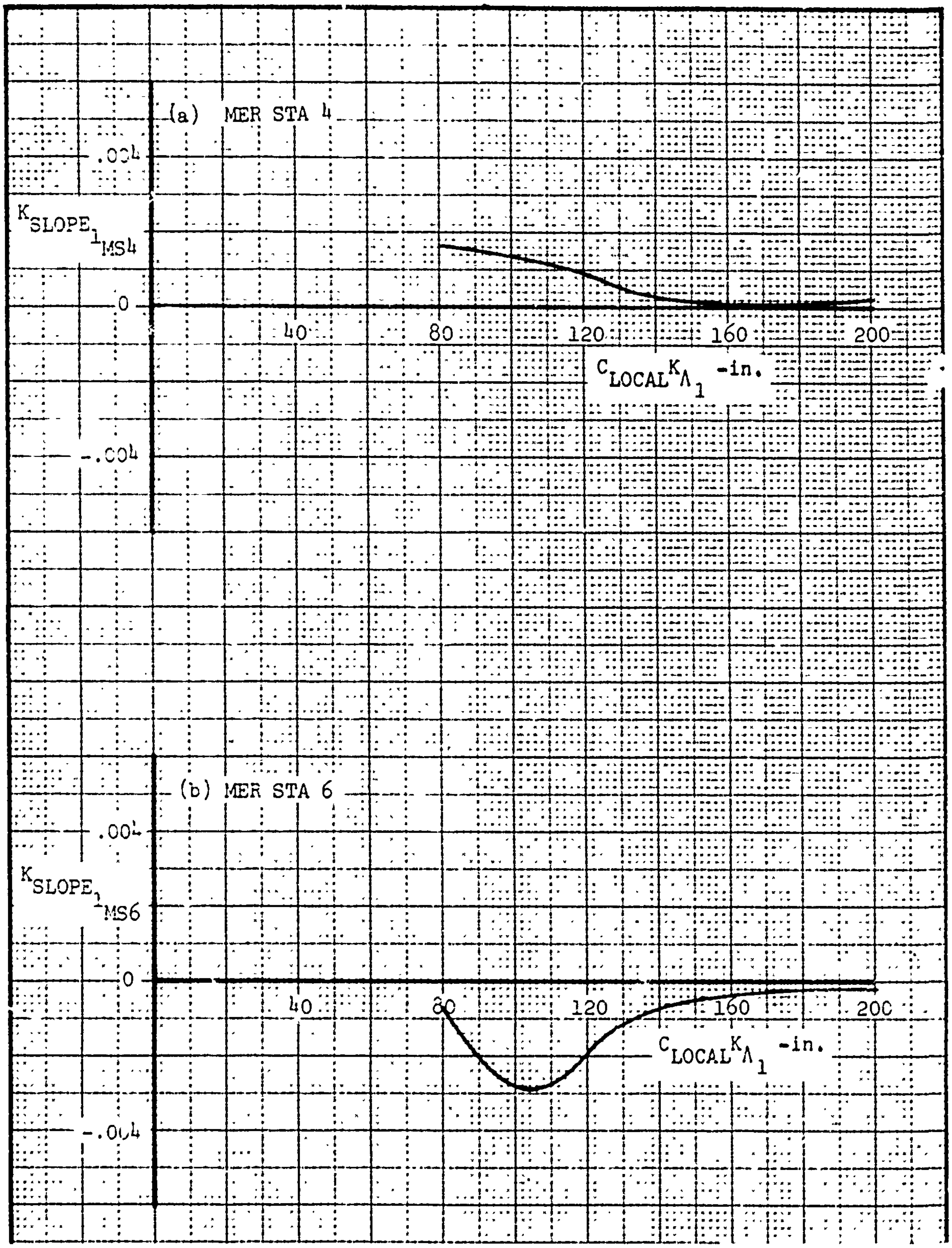


Figure 784. Rolling Moment Slope - K_{SLOPE_1} for MER Stations 4 and 6

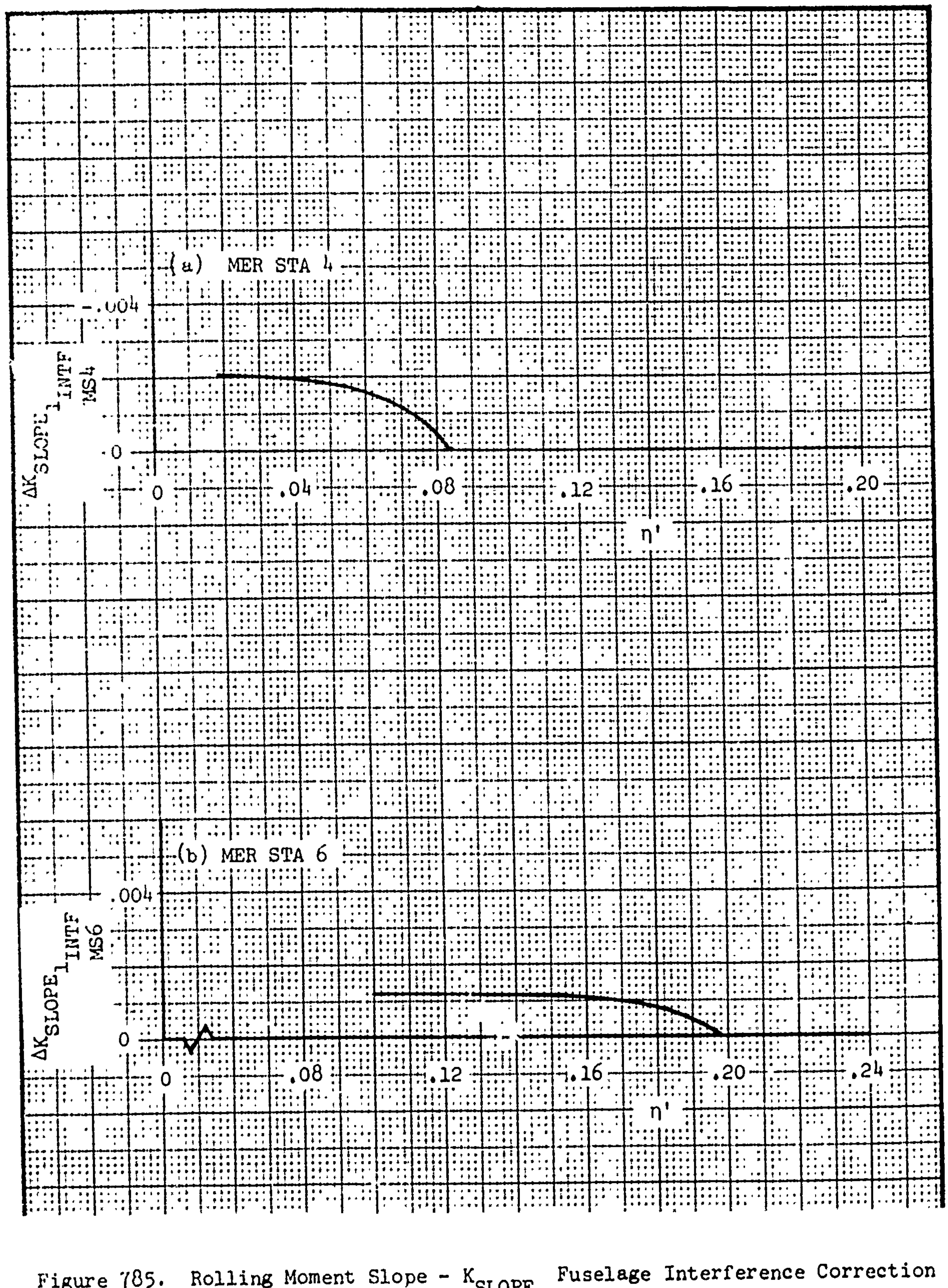


Figure 785. Rolling Moment Slope - K_{SLOPE_1} Fuselage Interference Correction for MER Stations 4 and 6

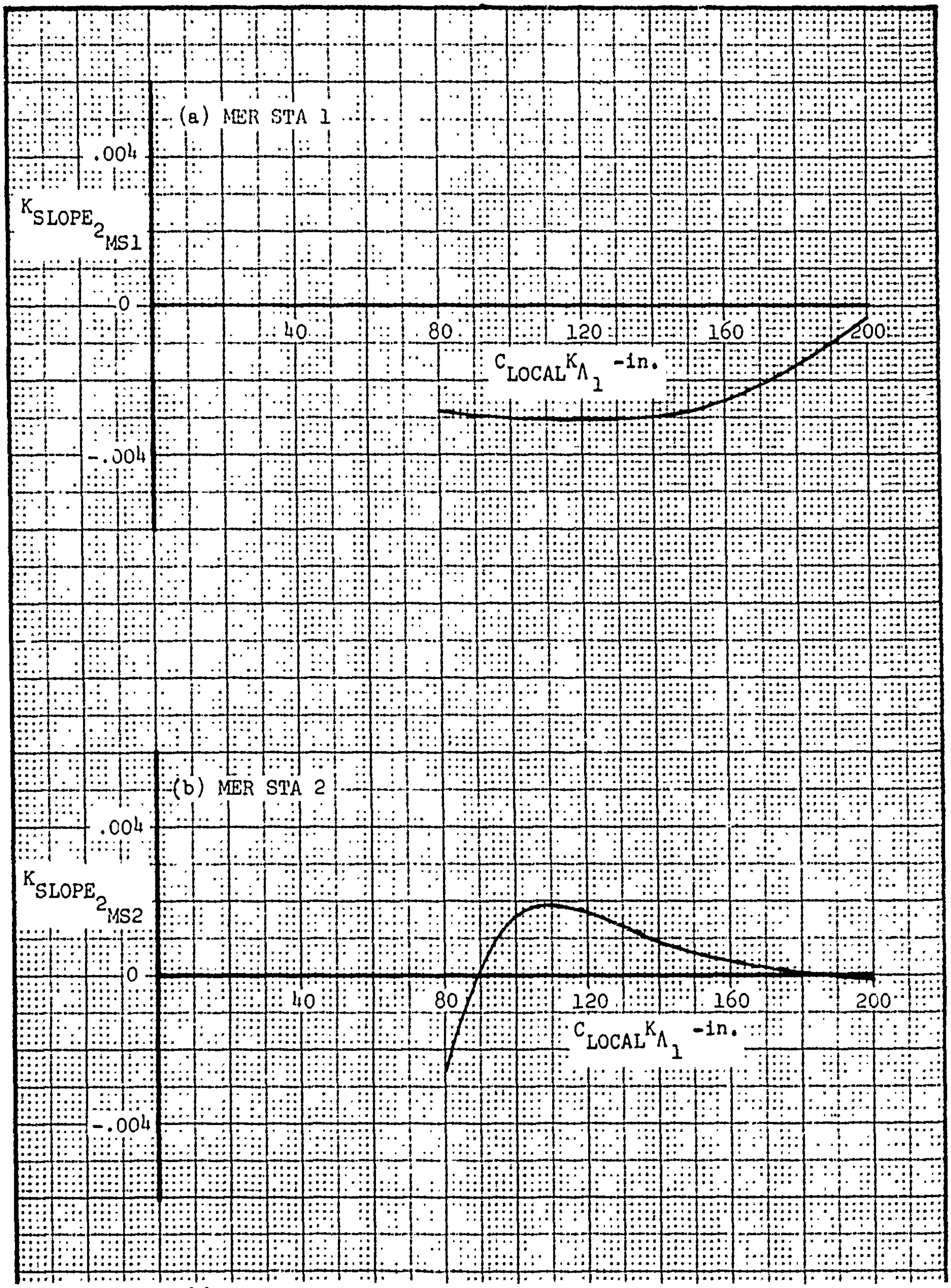


Figure 786. Rolling Moment Slope - K_{SLOPE_2} for MER Stations 1 and 2

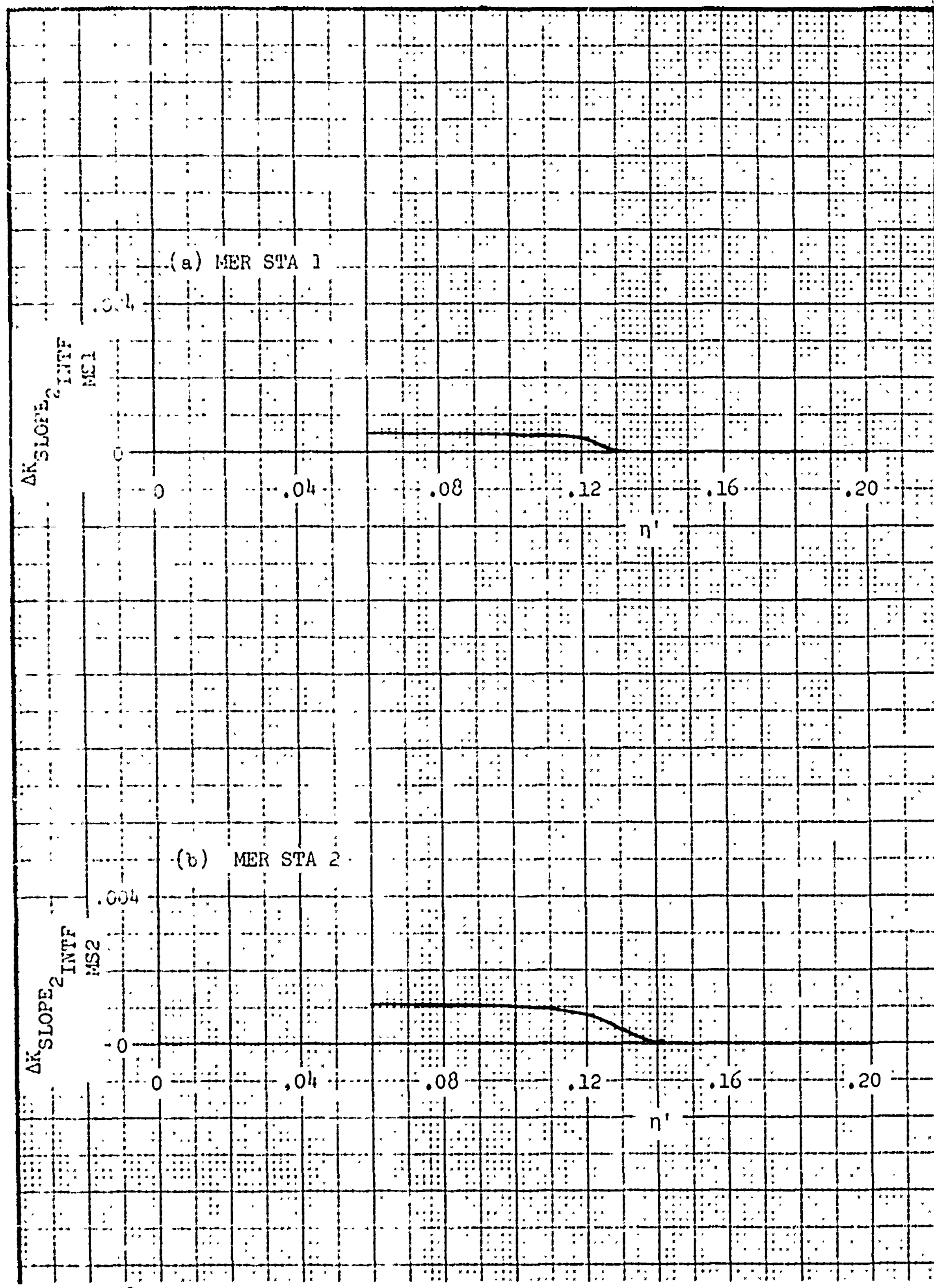


Figure 787. Rolling Moment Slope - K_{SLOPE_2} Fuselage Interference Correction for MER Stations 1 and 2

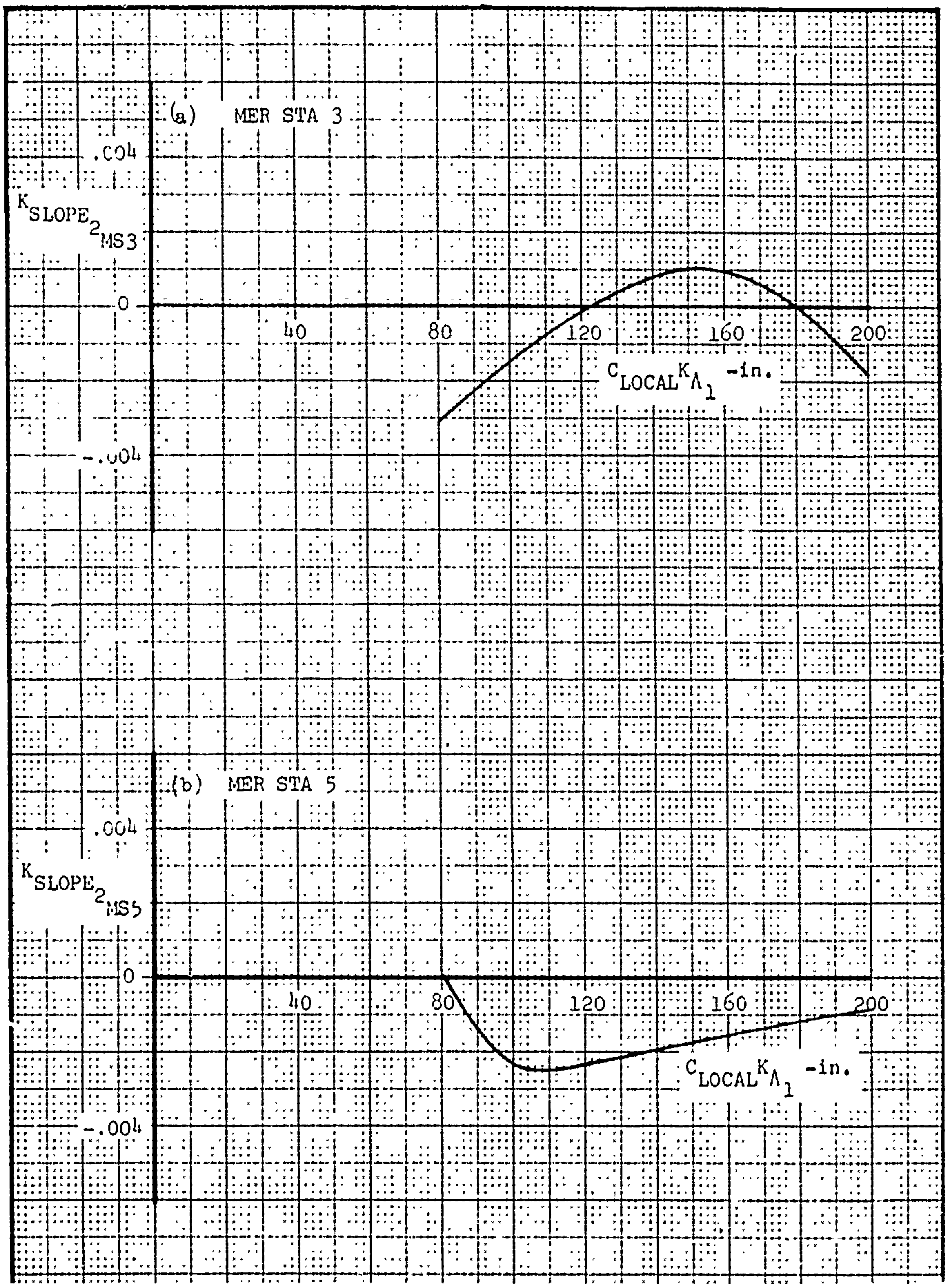


Figure 788. Rolling Moment Slope - K_{SLOPE_2} for MER Stations 3 and 5

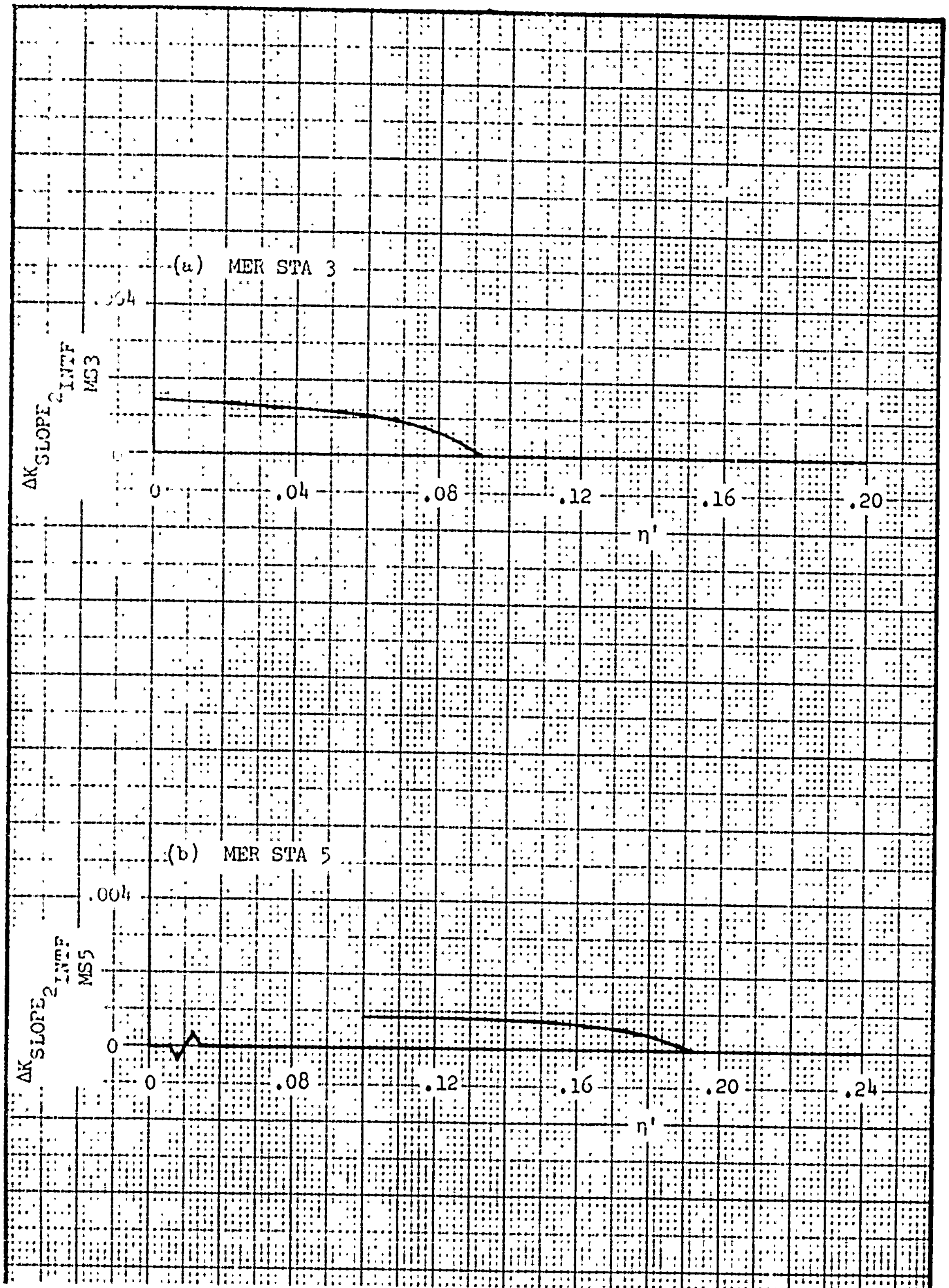


Figure 789. Rolling Moment Slope - K_{SLOPE_2} Fuselage Interference Correction for MER Stations 3 and 5

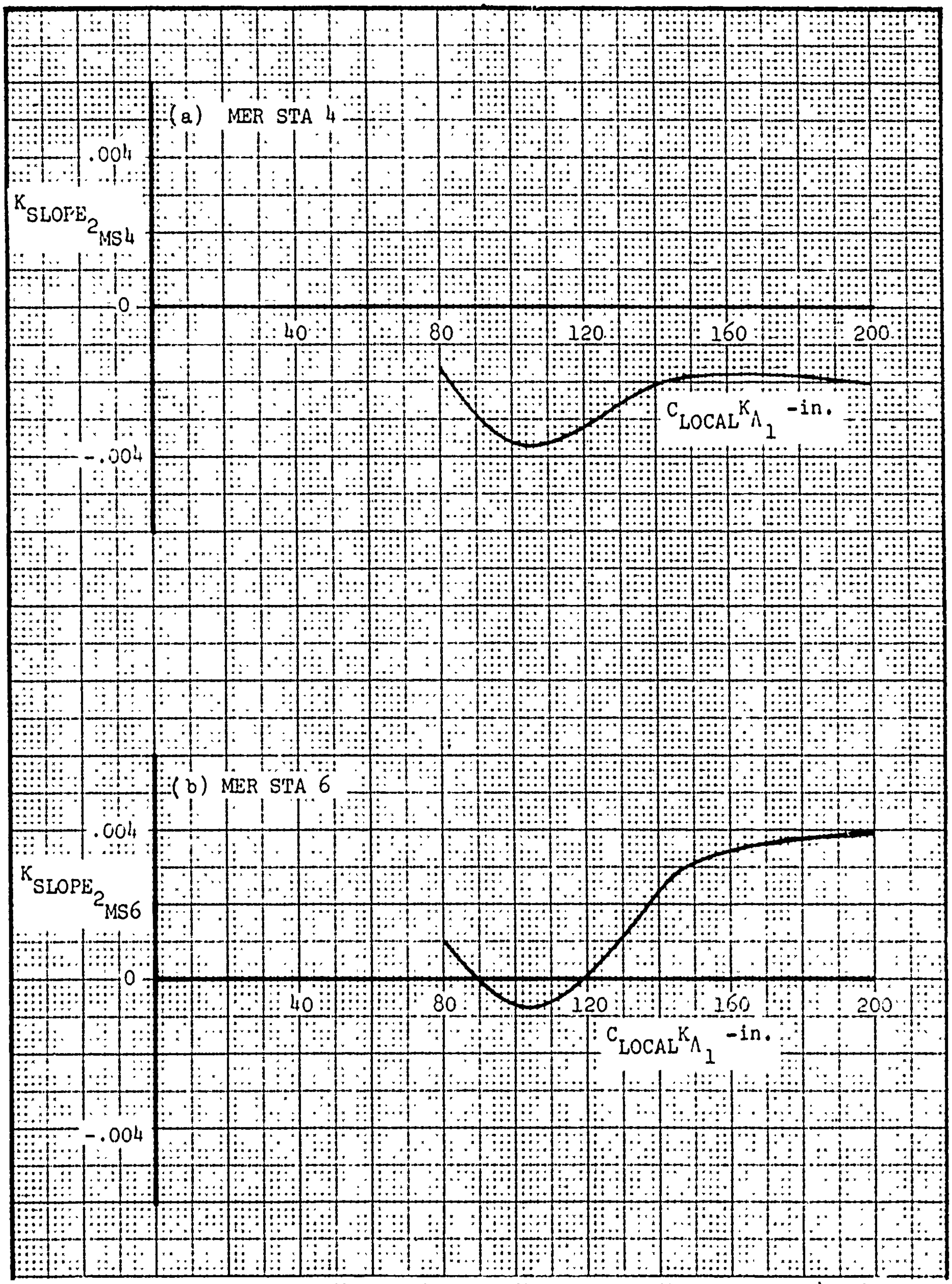


Figure 790. Rolling Moment Slope - K_{SLOPE_2} for MER Stations 4 and 6

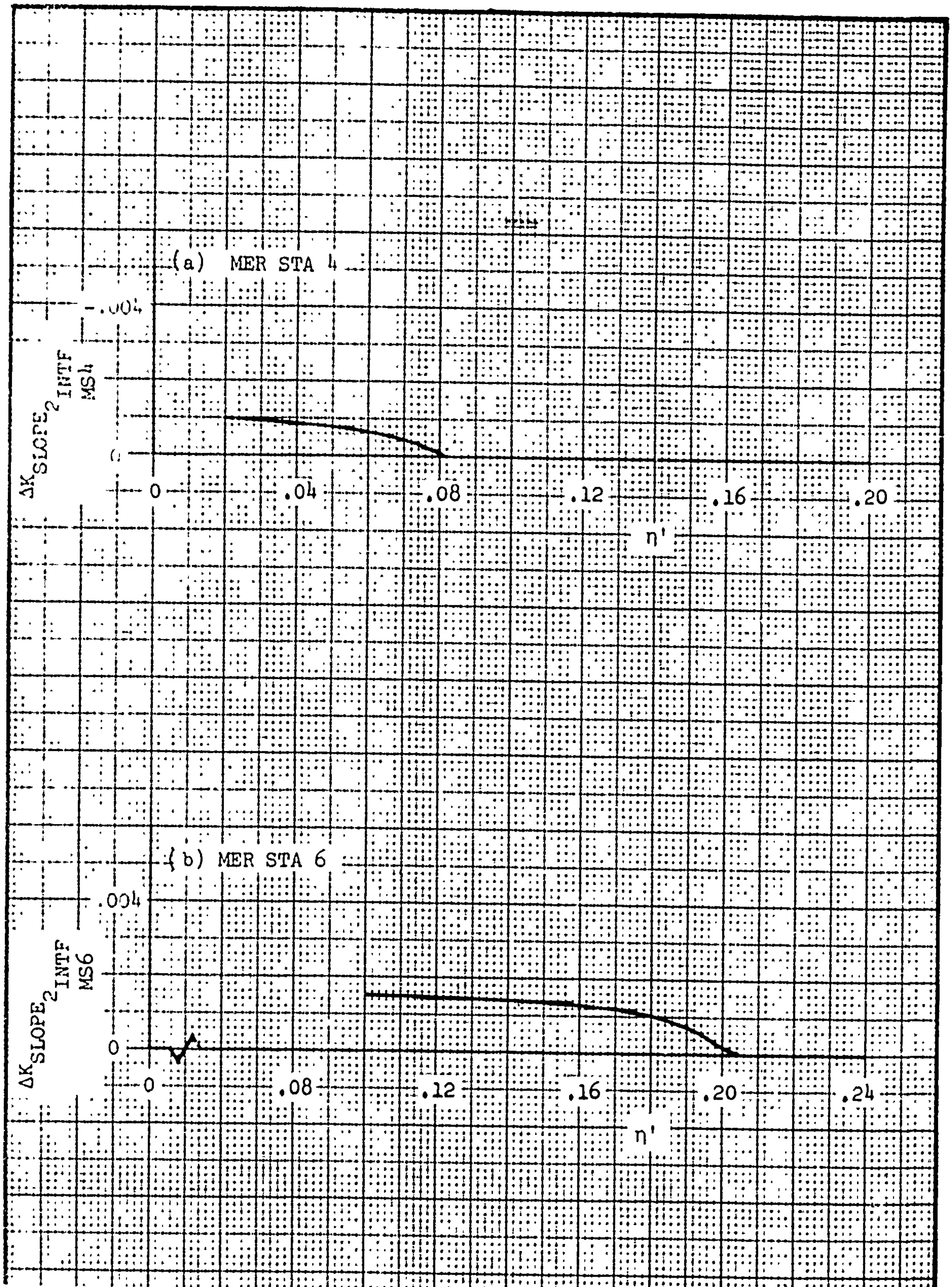


Figure 791. Rolling Moment Slope - K_{SLOPE_2} Fuselage Interference Correction for MER Stations 4 and 6

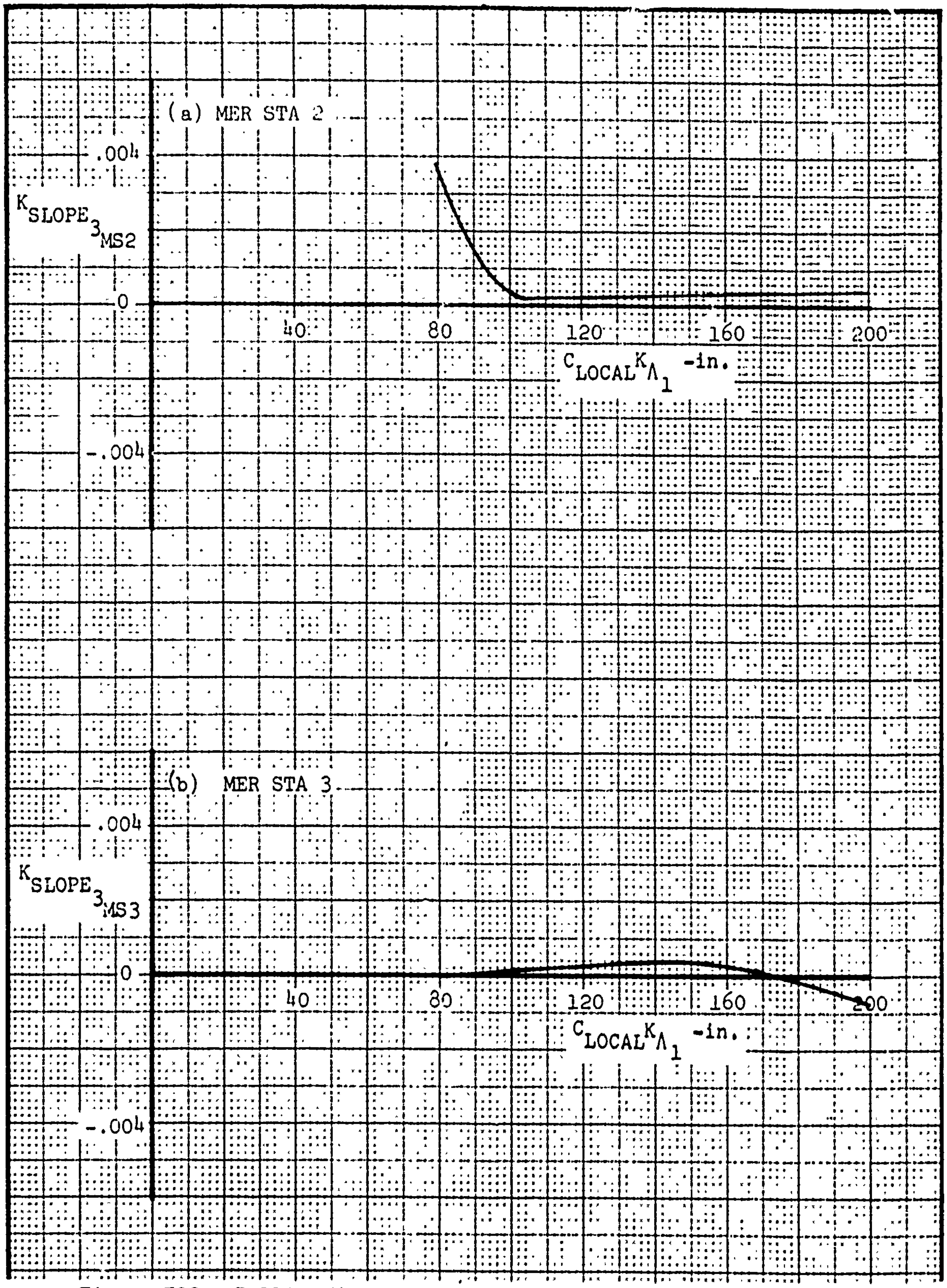


Figure 792. Rolling Moment Slope - K_{SLOPE_3} for MER Stations 2 and 3

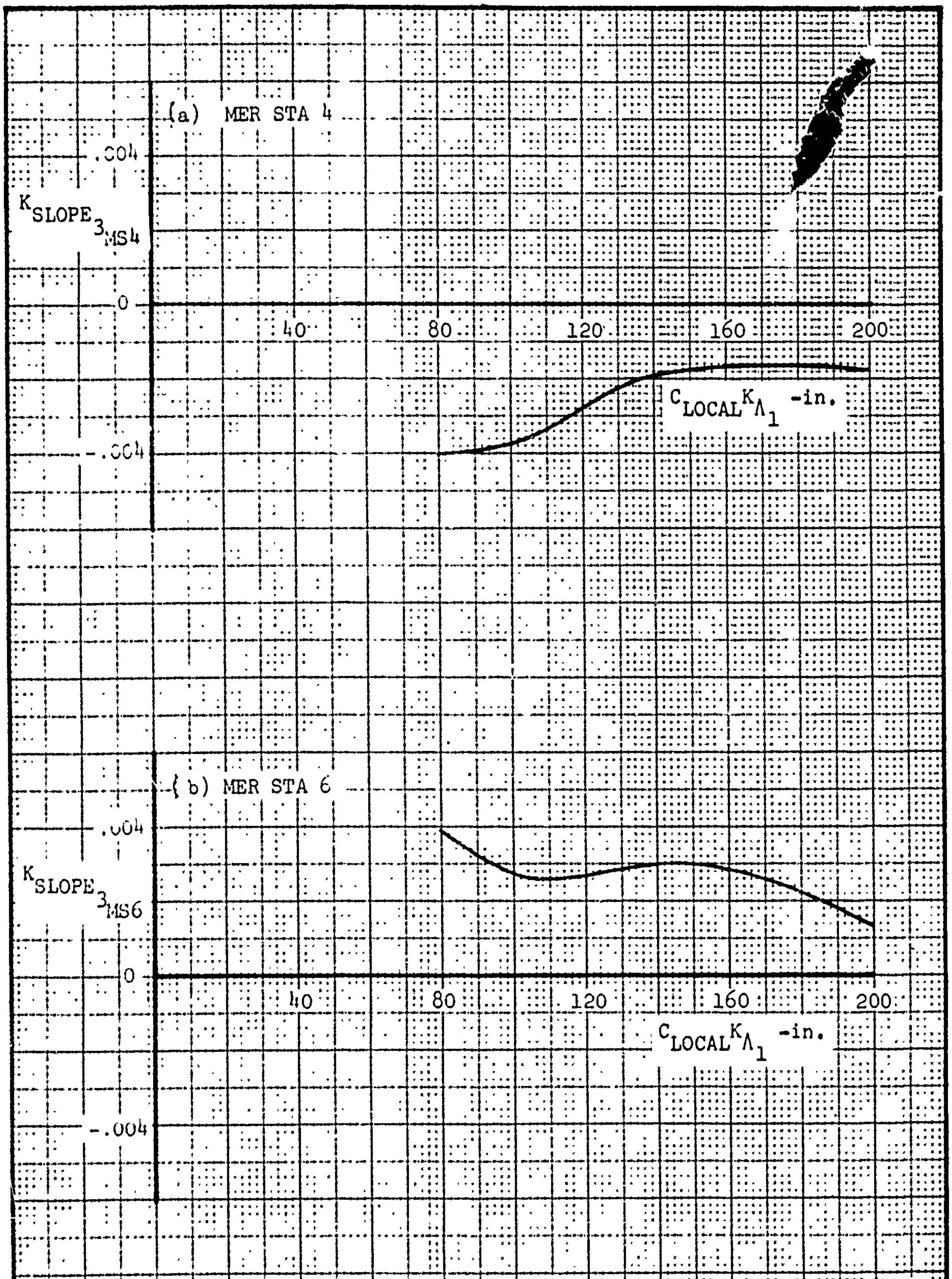


Figure 793. Rolling Moment Slope - K_{SLOPE_3} for MER Stations 4 and 6

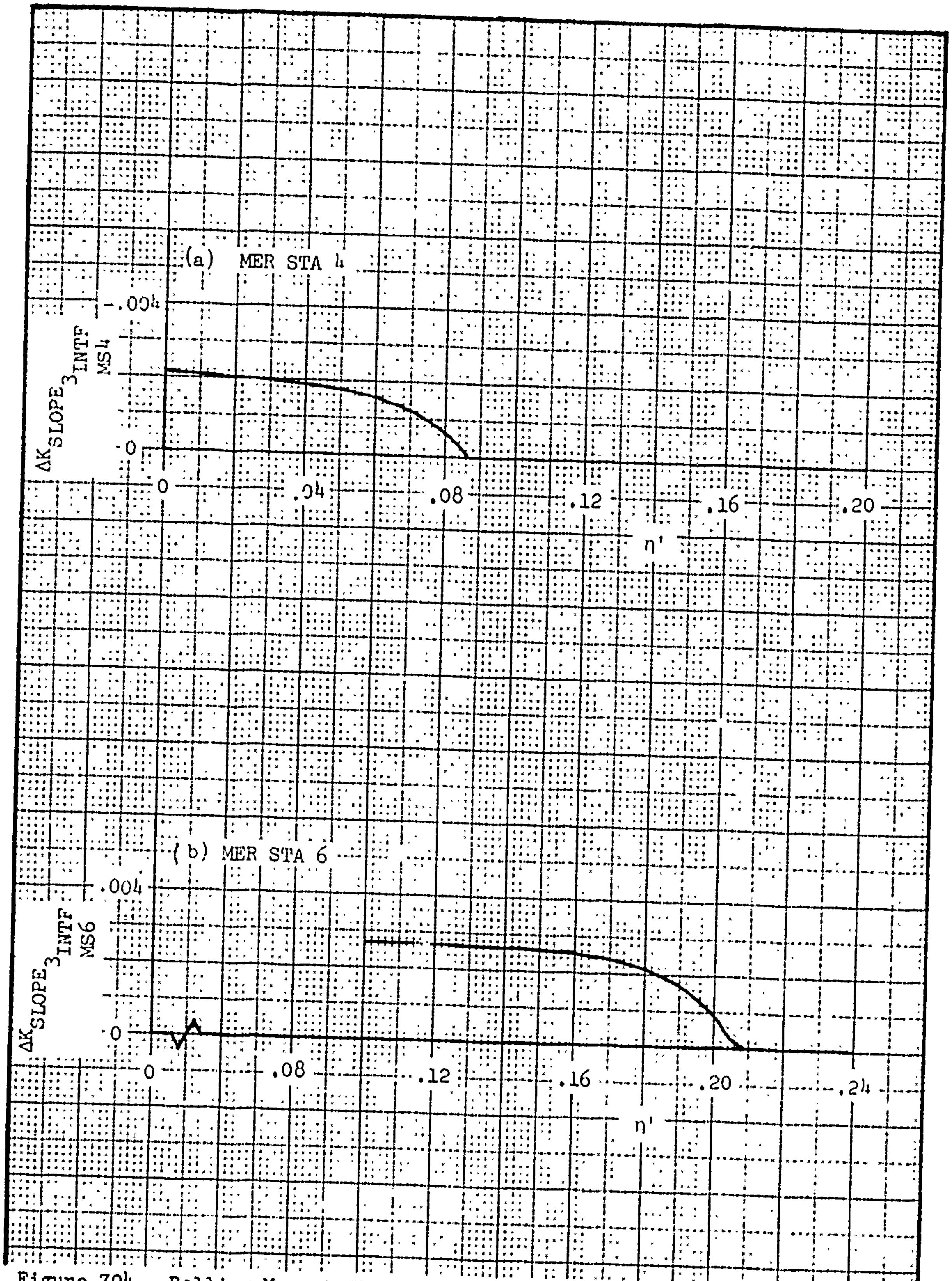


Figure 794. Rolling Moment Slope - K_{SLOPE_3} Fuselage Interference Correction for MER Stations 4 and 6

4.6.1.3 Intercept Prediction

The equations to predict rolling moment intercept at $M = 0.5$ are divided into two cases: fuselage centerline-mounted and wing-mounted stores.

FUSELAGE CENTERLINE MOUNTED STORES

MER STATIONS 1 and 2 (MS1,2):

$\left(\frac{RM}{q}\right)_{\substack{\alpha=0 \\ MS1,2}}$ is zero by reasons of symmetry.

MER STATIONS 3 and 4 (MS3,4):

$$\left(\frac{RM}{q}\right)_{\substack{\alpha=0 \\ MS3,4}} = K_{SLOPE_{\mathcal{L}_{MS3,4}}} \cdot \text{FIN AREA}$$

where:

$K_{SLOPE_{\mathcal{L}}}$ - Variation of rolling moment intercept with FIN AREA, ft $K_{SLOPE_{\mathcal{L}_{MS3}}} = -.00235$ and $K_{SLOPE_{\mathcal{L}_{MS4}}} = -.0124$

FIN AREA - Total planform area of all store fins, ft^2.

MER STATIONS 5 and 6 (MS5,6):

$$\left(\frac{RM}{q}\right)_{\substack{\alpha=0 \\ MS5 \\ MS6}} = -\left(\frac{RM}{q}\right)_{\substack{\alpha=0 \\ MS3 \\ MS4}}$$

where:

$\left(\frac{RM}{q}\right)_{\substack{\alpha=0 \\ MS3 \\ MS4}}$ - Value of rolling moment intercept obtained from preceding equation, ft^3.

WING-MOUNTED STORES

MER STATIONS 1, 3, and 5 (MS1, 3, 5):

$$\left(\frac{RM}{q}\right)_{\alpha_{MS1,3,5}} = K_{SLOPE_{1_{MS1,3,5}}} \cdot \text{FIN AREA}$$

where:

K_{SLOPE_1} - Variation of rolling moment intercept with FIN AREA, ft.

MER STA 1 - Figure 795

MER STA 3 - Figure 797

MER STA 5 - Figure 797

FIN AREA - Total planform area of all store fins, ft^2.

MER STATIONS 2,4 and 6 (MS2,4,6):

$$\left(\frac{RM}{q}\right)_{\alpha_{MS2,4,6}} = \left(K_{SLOPE_{1_{MS2,4,6}}} + \Delta K_{SLOPE_{INTF_{MS2,4,6}}}\right) \text{FIN AREA}$$

where:

K_{SLOPE_1} - Variation of rolling moment intercept with FIN AREA, ft.

MER STA 2 - Figure 795

MER STA 4 - Figure 798

MER STA 6 - Figure 798

$\Delta K_{SLOPE_{INTF}}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high-wing aircraft, ft.

MER STA 2 - Figure 796

MER STA 4 - Figure 799

MER STA 6 - Figure 799

FIN AREA - Total planform area of all store fins, ft^2.

A numerical example illustrating the use of the above equation is found in Subsection 4.6.1.1.

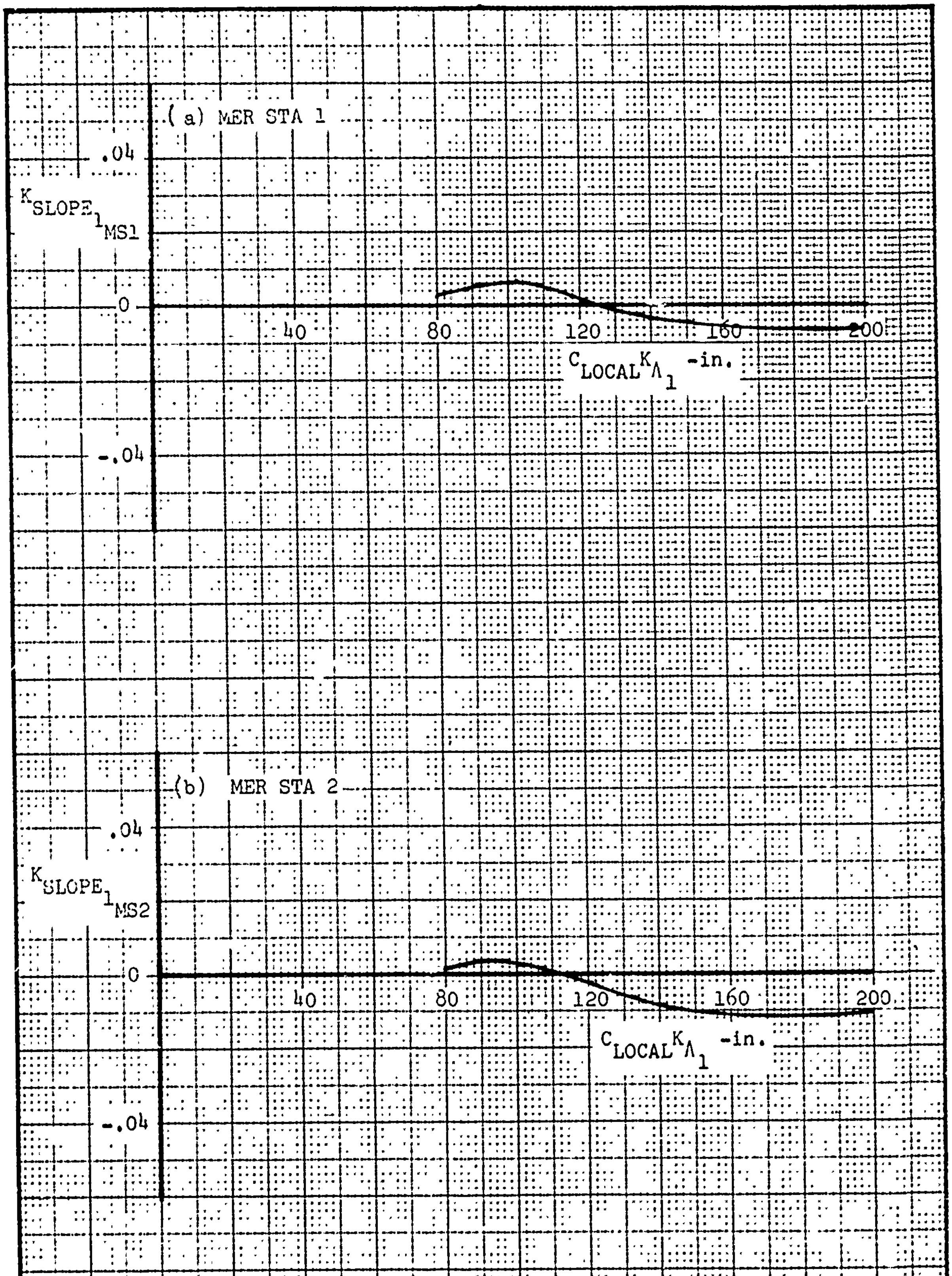


Figure 795. Rolling Moment Intercept - Variation with Fin Area for MER Stations 1 and 2

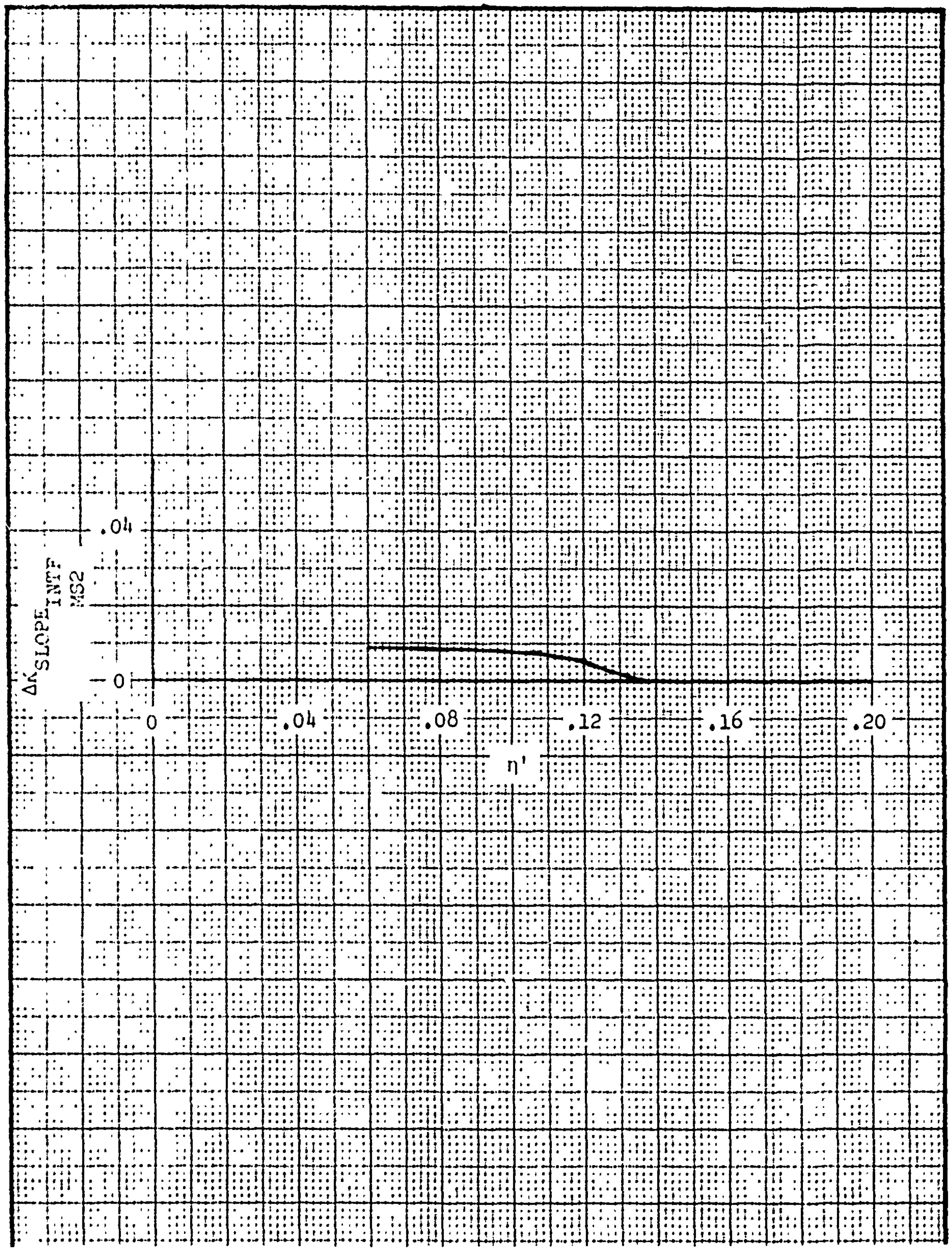


Figure 796. Rolling Moment Intercept - K_{SLOPE_1} Fuselage Interference Correction for MER Station 2

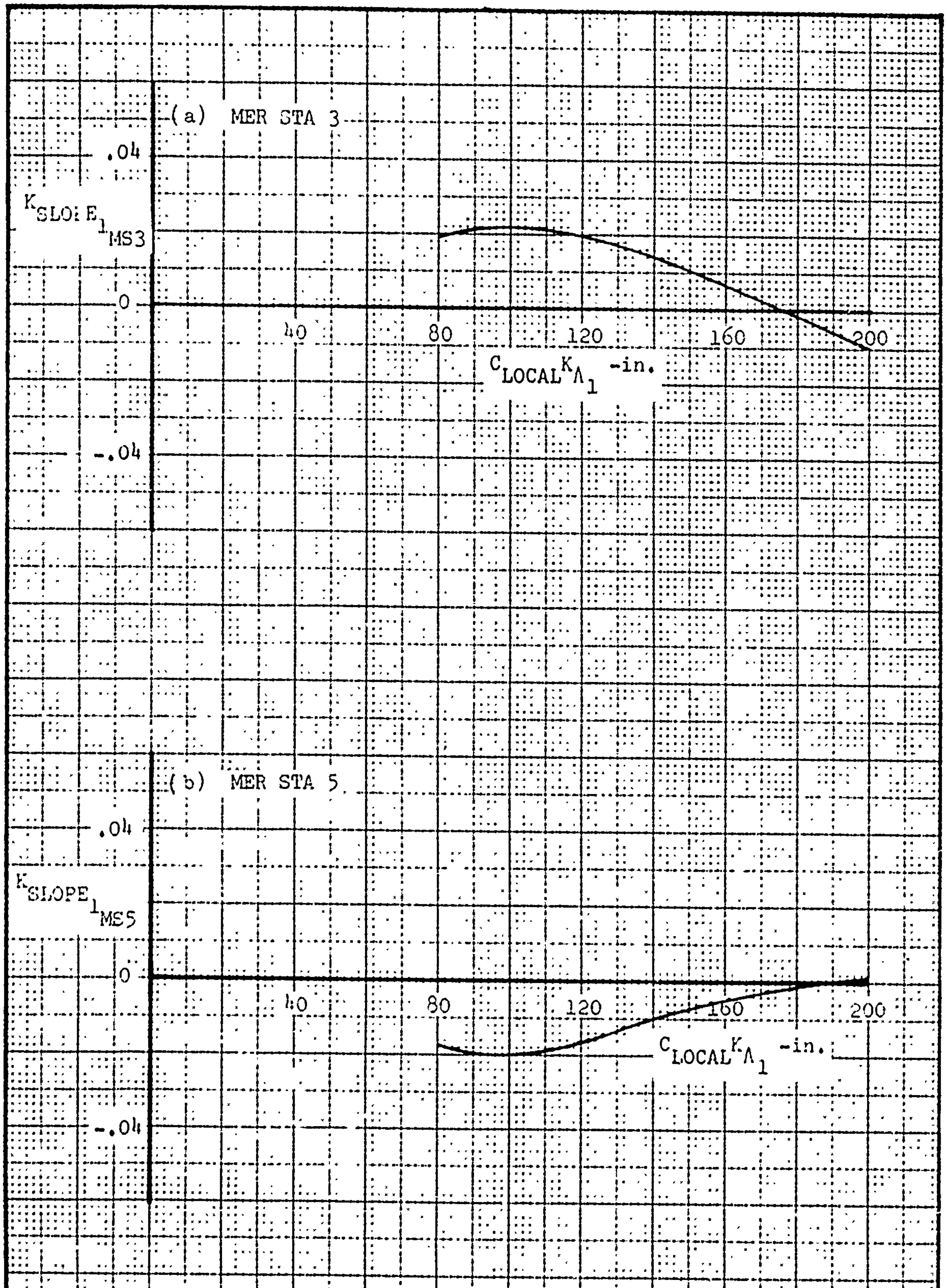


Figure 797. Rolling Moment Intercept - Variation with Fin Area for MER Stations 3 and 5

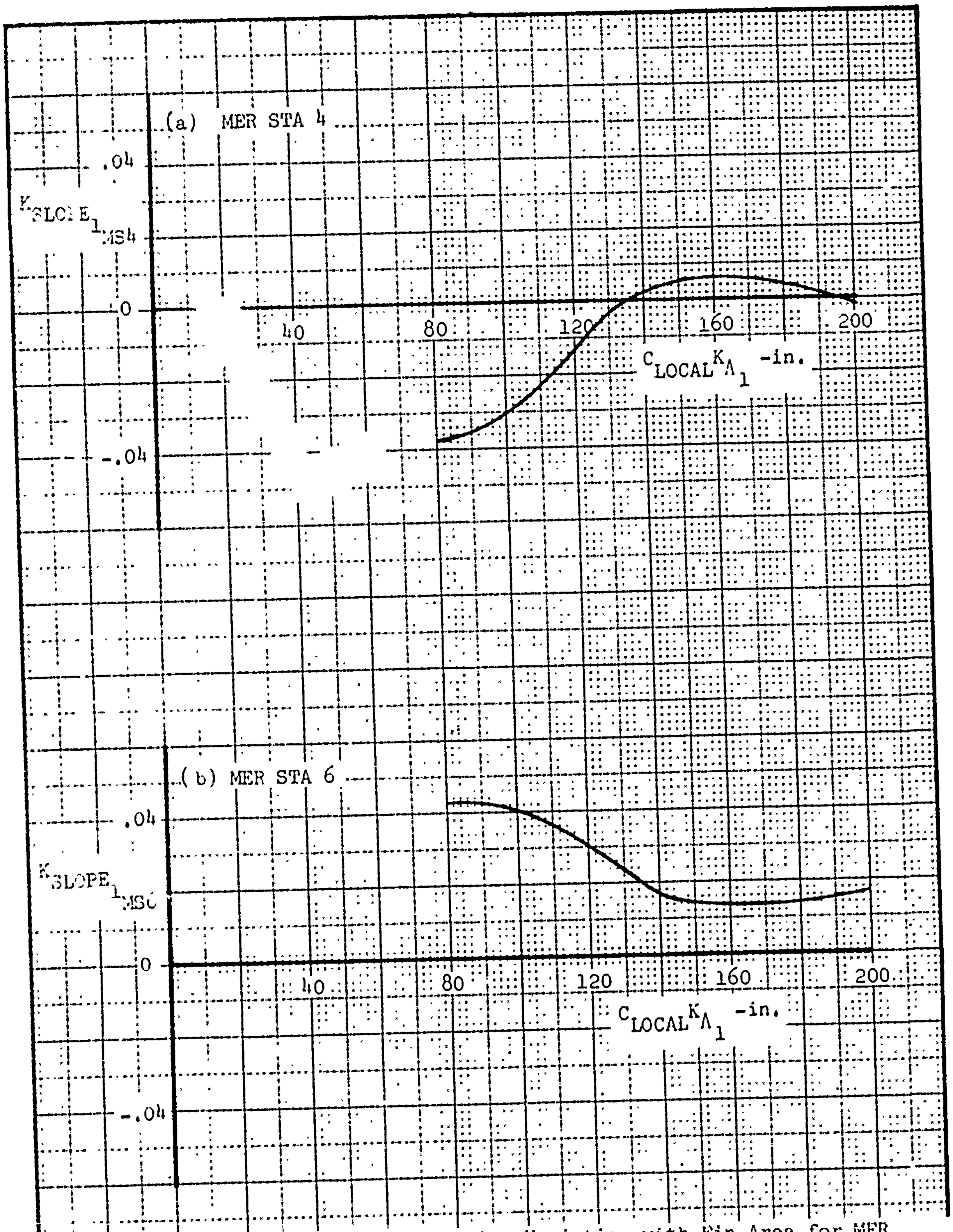


Figure 798. Rolling Moment Intercept - Variation with Fin Area for MER Stations 4 and 6

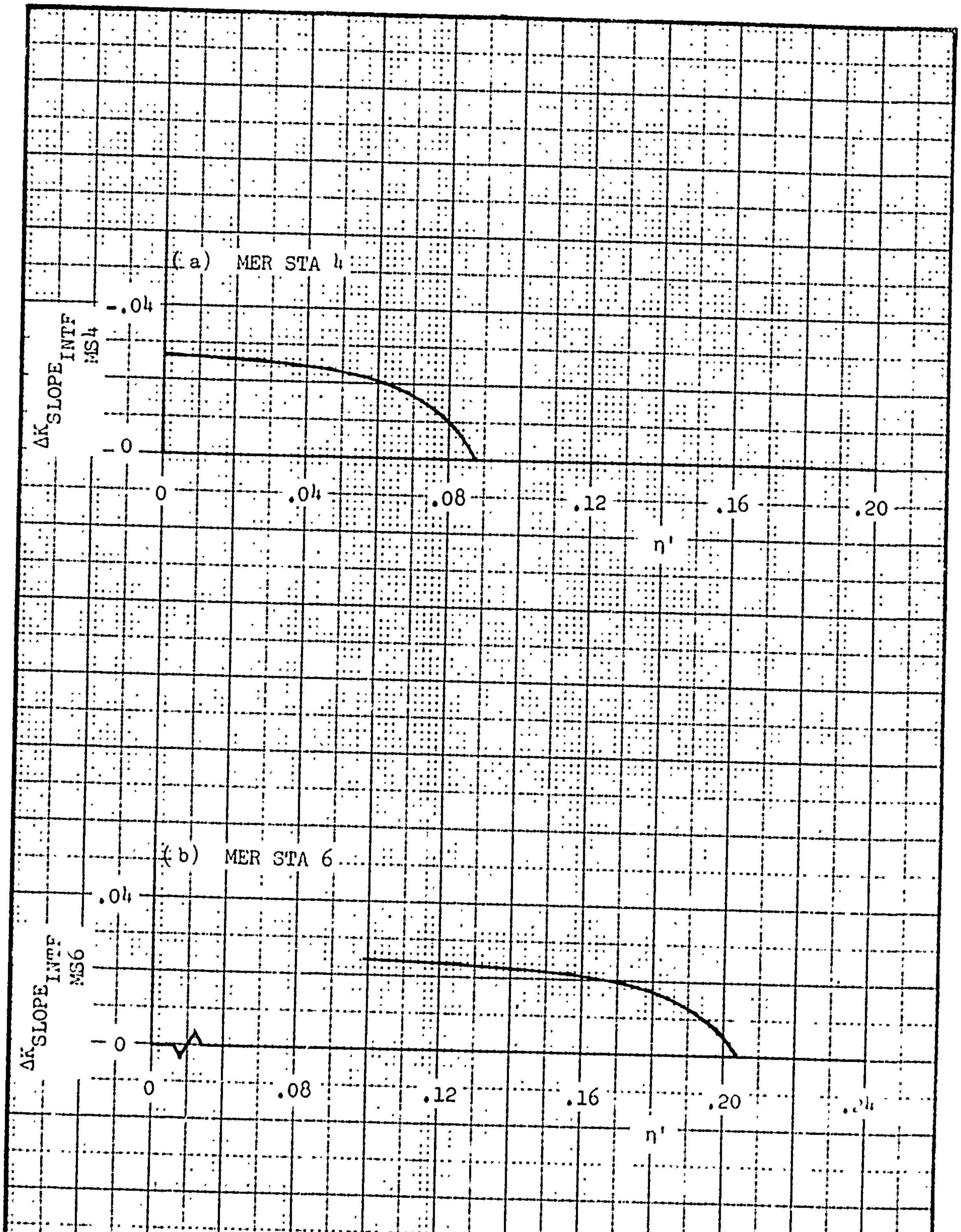


Figure 799. Rolling Moment Intercept - K_{SLOPE_1} Fuselage Interference Correction for MER Stations 4 and 6

4.6.1.4 Intercept Mach Number Correction

The equation to predict rolling moment intercept between M = 0.5 and M = 1.6 is as follows.

$$\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M=x}} = \left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M=0.5}} + \Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M=x}}$$

where:

$\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M=0.5}}$ - Value of rolling moment intercept at M = 0.5 from Subsection 4.6.1.1, ft^3.

$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M=x}}$ - Incremental change in rolling moment intercept with Mach number from the value predicted at M = 0.5, ft^3.

As in the preceding section the incremental change with Mach number prediction has been divided into cases of fuselage centerline-mounted and wing-mounted stores.

FUSELAGE CENTERLINE-MOUNTED STORES

MER STATIONS 1 and 2 (MS1,2):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0} = 0 \text{ by symmetry.}$$

MER STATIONS 3 and 4 (MS3,4):

$$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\MS3,4}} = \Delta K_{SLOPE_{1}\,MS3,4} \text{ FIN AREA}$$

where:

ΔK_{SLOPE_1} - Variation of incremental rolling moment intercept with FIN AREA, ft,

MER STA 3 - Figure 801

MER STA 4 - Figure 802

FIN AREA - Total planform area of all store fins, ft^2.

MER STATIONS 5 and 6 (MS5,6):

$$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\ MS5\\ MS6}} = -\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\ MS3\\ MS4}}$$

where:

$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\ MS3\\ MS4}}$ - Value of rolling moment intercept obtained from MS3,4 computation above.

WING-MOUNTED STORES

A generalized curve of rolling moment intercept variation Mach number is shown in Figure 800.

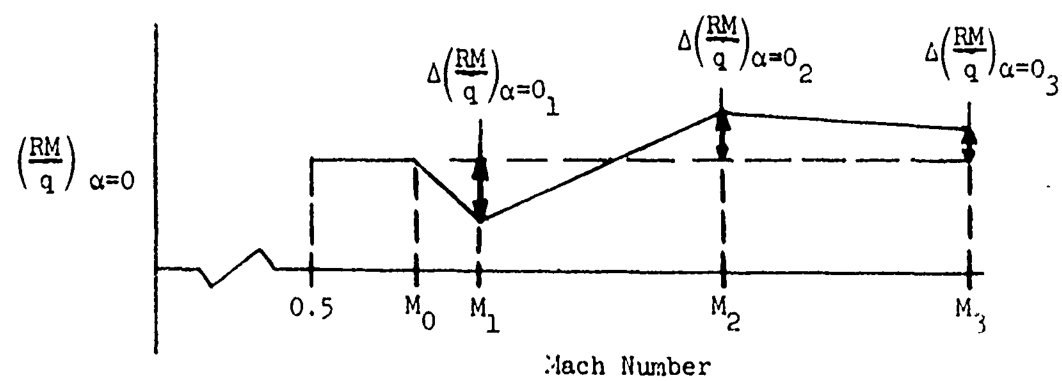


Figure 800. Rolling Moment Intercept - Generalized Mach Number Variation

The rolling moment variation with Mach number has been approximated by a series of linear segments with breaks occurring

at Mach numbers designated by M_0, $M_{\bullet}$, M_3 for each of the six MER stations. These Mach break points are presented as a function of $C_{LOCAL}K_{\Lambda}$ in Figure 803 (MS 1,2), Figure 804 (MS3,5) and Figure 805 (MS 4,6). M_0 is the Mach number where the intercept initially deviates from the value predicted at M = 0.5. Equations have been developed to predict the incremental intercept changes from the value predicted at M = 0.5 for each of the remaining Mach break points. These equations are presented below:

BREAK 1 (M_1):

MER STATIONS 1,3,4,5,6 (MS1,3-6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_1 \atop MS1,3-6} = \left(K_{SLOPE_1 \atop MS1,3-6} + \Delta K_{SLOPE_1 \atop INTF \atop MS1,3-6}\right) \text{FIN AREA}$$

where:

K_{SLOPE_1} - Variation of incremental rolling moment intercept with FIN AREA, ft.

MER STA 1 - Figure 806
MER STA 3 - Figure 808
MER STA 4 - Figure 810
MER STA 5 - Figure 808
MER STA 6 - Figure 810

$\Delta K_{SLOPE_1 \atop INTF}$ - Incremental change in K_{SLOPE_1} due to interference effect of the fuselage for high-wing aircraft, ft ,

MER STA 1 - Figure 807
MER STA 3 - Figure 809
MER STA 4 - Figure 811
MER STA 5 - Figure 809
MER STA 6 - Figure 811

FIN AREA - Total planform area of all store fins, ft^2.

MER STATION 2 (MS2):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{1_{MS2}}} = K_{SLOPE_{1_{MS2}}} \text{ FIN AREA}$$

where:

K_{SLOPE_1} - Variation of incremental rolling moment intercept with FIN AREA, ft ,
MER STA 2 - Figure 806

FIN AREA - Total planform area of all store fins, ft^2.

BREAK 2 (M_2):

MER STATIONS 1,4 and 6 (MS1,4,6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{2_{MS1,4,6}}} = \left(K_{SLOPE_{2_{MS1,4,6}}} + \Delta K_{SLOPE_{2_{INTF_{MS1,4,6}}}}\right)\text{FIN AREA}$$

where:

K_{SLOPE_2} - Variation of incremental rolling moment intercept with FIN AREA, ft.
MER STA 1 - Figure 812
MER STA 4 - Figure 815
MER STA 6 - Figure 815

$\Delta K_{SLOPE_{2_{INTF}}}$ - Incremental change in K_{SLOPE_2} due to interference effect of the fuselage for high-wing aircraft, ft.
MER STA 1 - Figure 813
MER STA 4 - Figure 816
MER STA 6 - Figure 816

FIN AREA - Total planform area of all store fins, ft^2.

MER STATIONS 2,3 and 5 (MS2,3,5):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{2}\ MS2,3,5} = K_{SLOPE_{2}\ MS2,3,5} \cdot \text{FIN AREA}$$

where:

K_{SLOPE_2} - Variation of incremental rolling moment intercept with FIN AREA, ft^2.

MER STA 2 - Figure 812

MER STA 3 - Figure 814

MER STA 5 - Figure 814

Break 3 (M_3):

MER STATIONS 2 and 3 (MS2,3):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{3}\ MS2,3} = K_{SLOPE_{3}\ MS2,3} \cdot \text{FIN AREA}$$

where:

K_{SLOPE_3} - Variation of incremental rolling moment intercept with FIN AREA, ft.

MER STA 2 - Figure 817

MER STA 3 - Figure 817

FIN AREA- Total planform area of all store fins, ft^2.

MER STATIONS 4 and 6 (MS4,6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{3}\ MS4,6} = (K_{SLOPE_{3}\ MS4,6} + \Delta K_{SLOPE_{3}\ INTF\ MS4,6})\ \text{FIN AREA}$$

where:

K_{Slope_3} - Variation of incremental rolling moment intercept with FIN AREA, ft ,
MER STA 4 - Figure 818
MER STA 6 - Figure 818

$\Delta K_{SLOPE_{3}\,INTF}$ - Incremental change in K_{SLOPE_3} due to interference effect of the fuselage for high-wing aircraft, ft
MER STA 4 - Figure 819
MER STA 6 - Figure 819

FIN AREA - Total planform area of all store fins, ft^2.

To compute $\left(\frac{RM}{q}\right)_{\alpha=0}$ at M=x, first determine from Figures 803 to 805 between which Mach break points M=x occurs using the appropriate MER station curve. Let M_{LOW} be the lower Mach break and M_{HI} be the higher Mach break point. Then compute $\left(\frac{RM}{q}\right)_{\alpha=0}$ at M=x from the following expression.

$$\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M=x}} = \left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M=0.5}} + \Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M_{LOW}}} + \left(\frac{x - M_{LOW}}{M_{HI} - M_{LOW}}\right)$$

$$\left[\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M_{HI}}} - \Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\M_{LOW}}}\right]$$

If $x \leq M_0$, then $\left(\frac{RM}{q}\right)_{\alpha=0}$ at M=x is equal to the value of Subsection 4.6.1.3 (the initial term of the above equation).

A numerical example illustrating the use of the above equation is found in Subsection 4.1.1.2.

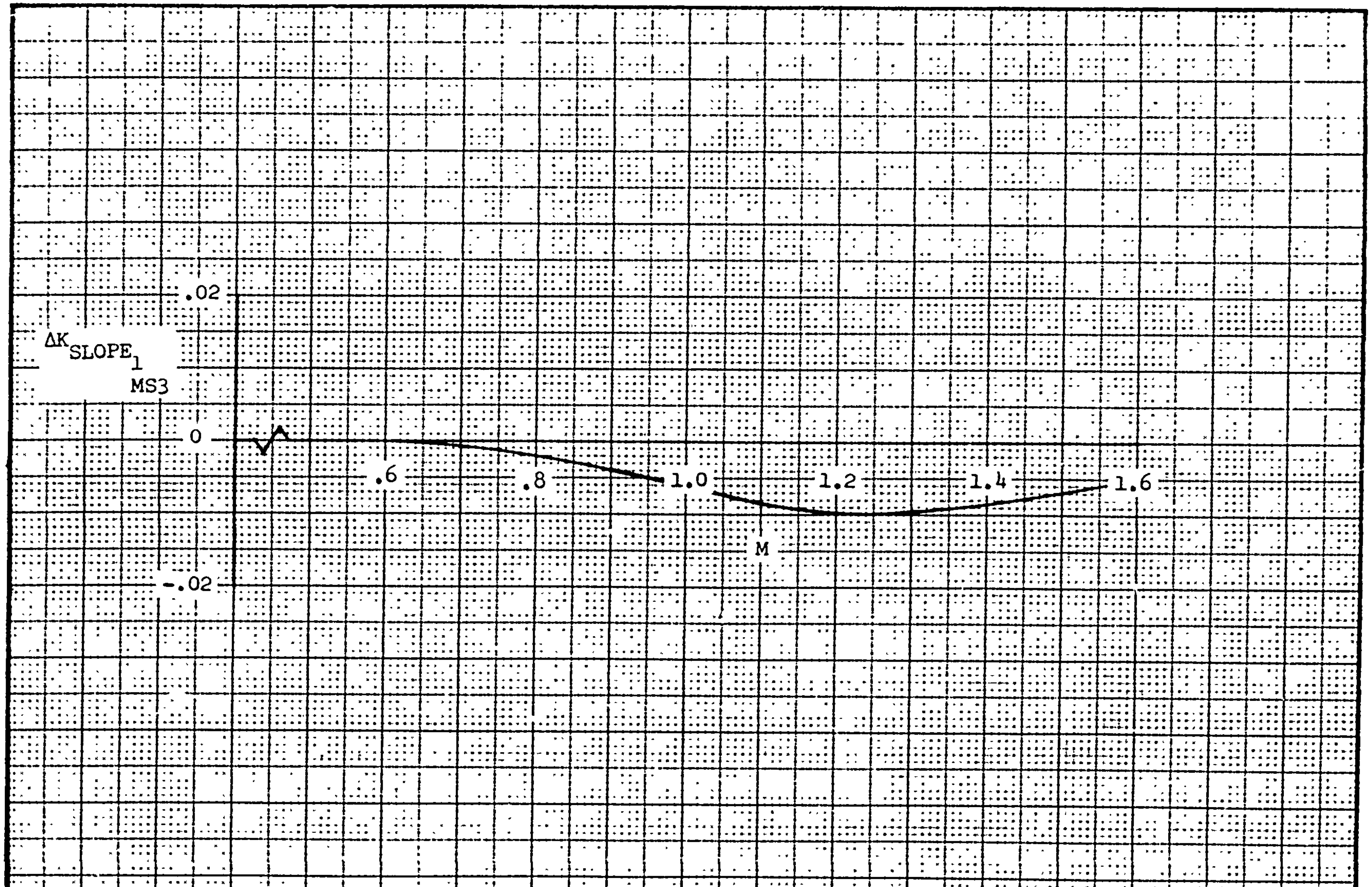


Figure 801. Rolling Moment Intercept - Incremental Variation with Fin Area for MER Station 3

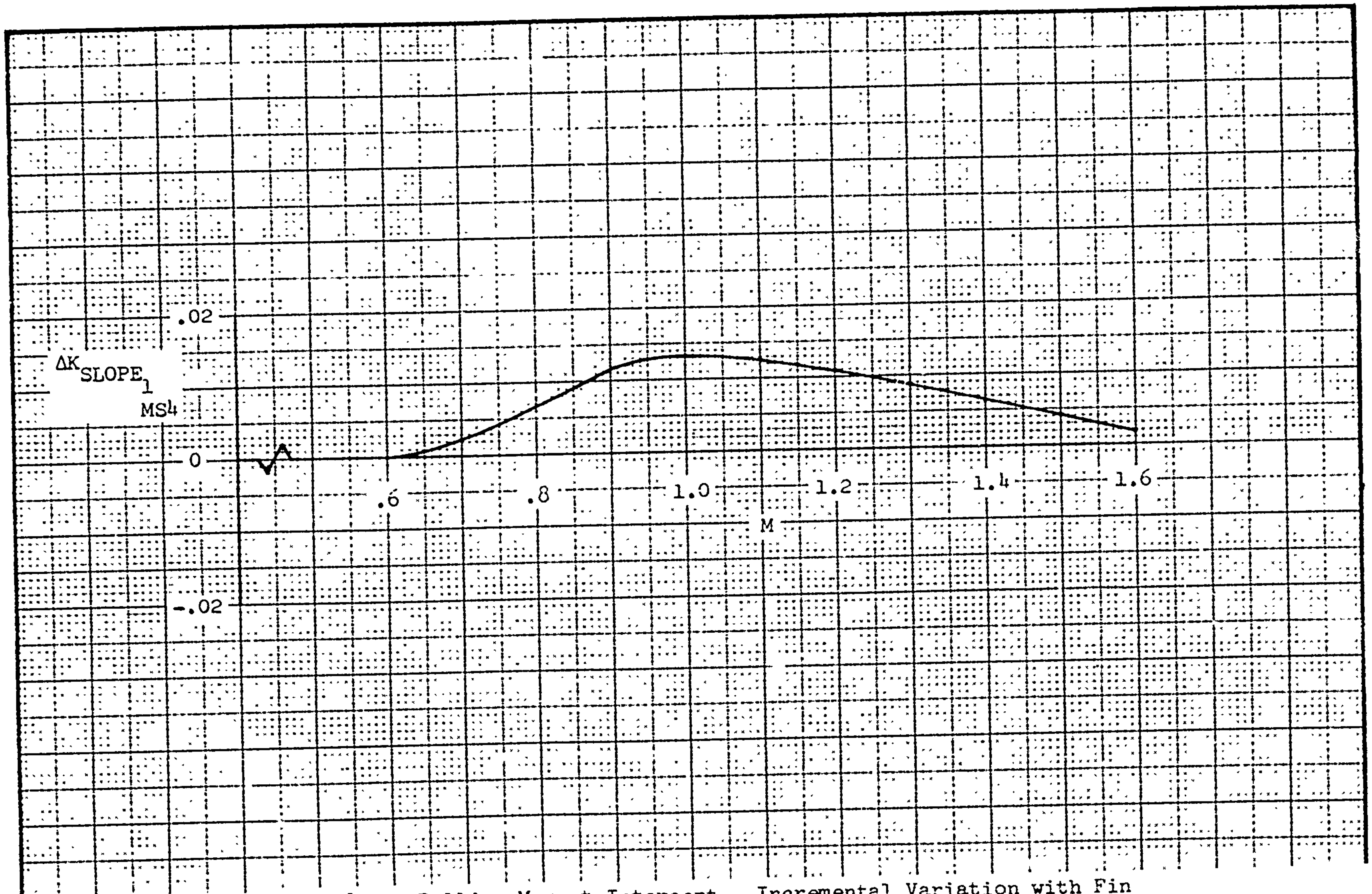


Figure 802. Rolling Moment Intercept - Incremental Variation with Fin Area for MER Station 4

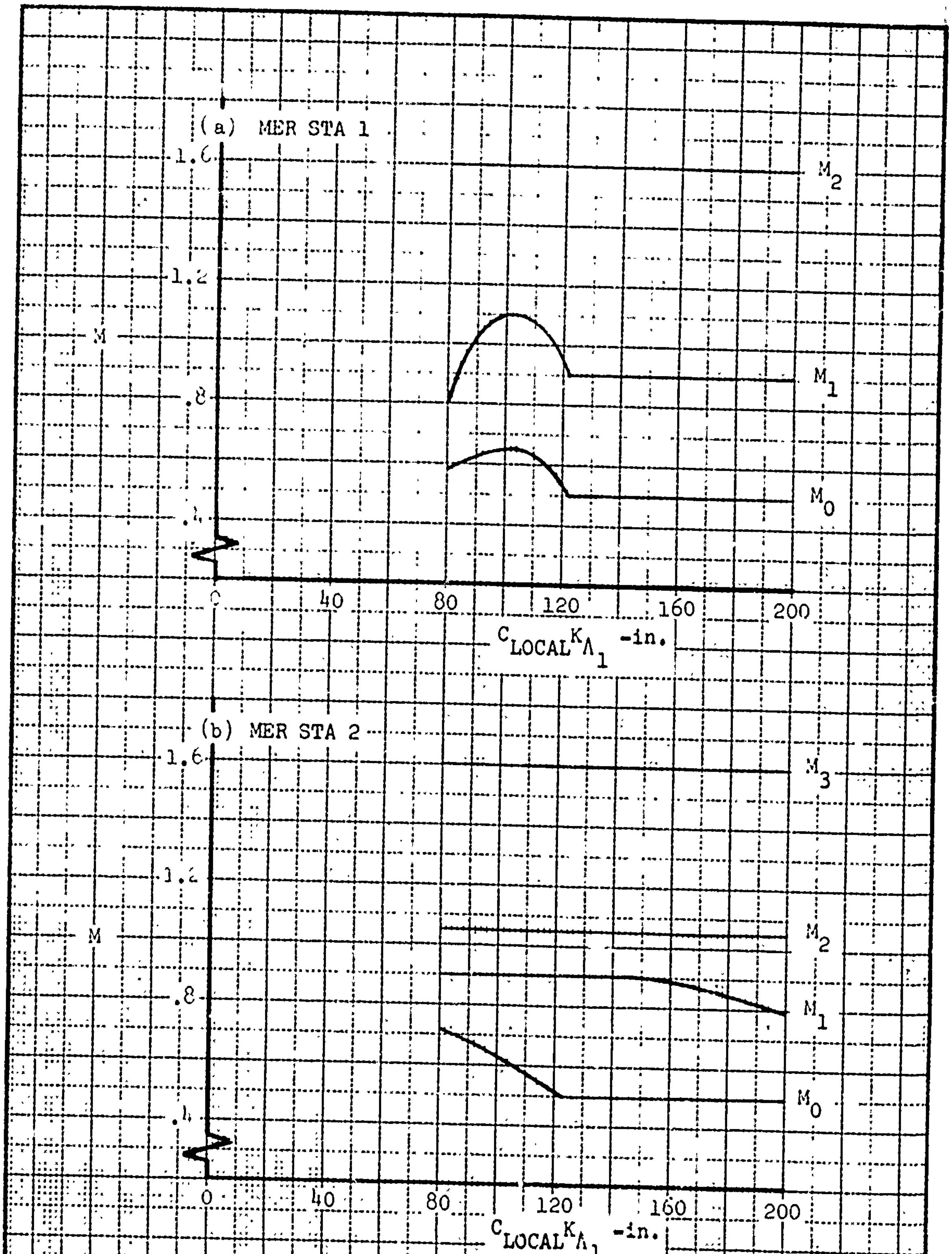


Figure 803. Rolling Moment Intercept - Mach Number Break Points for MER Stations 1 and 2

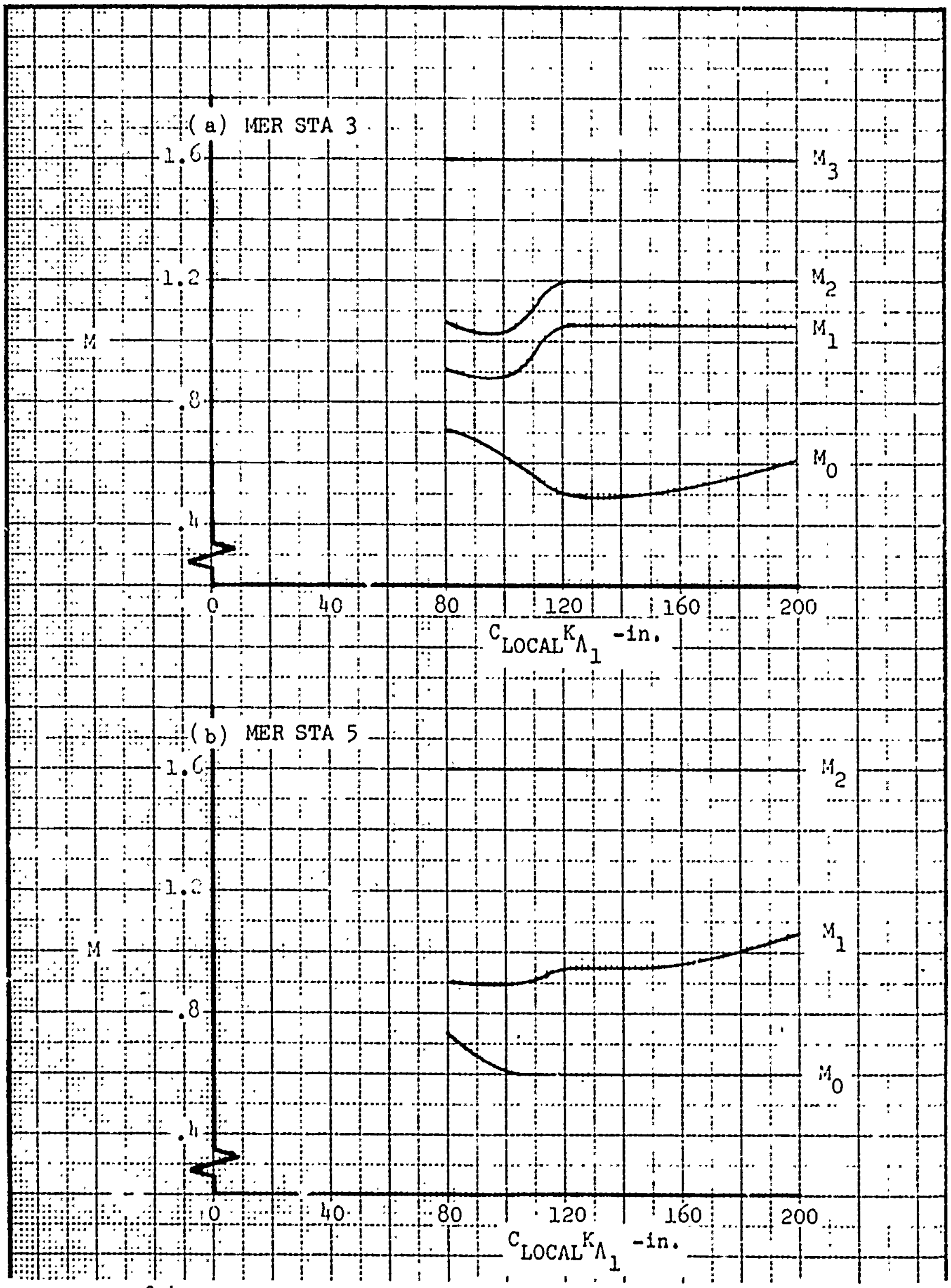


Figure 804. Rolling Moment Intercept - Mach Number Break Points for MER Stations 3 and 5

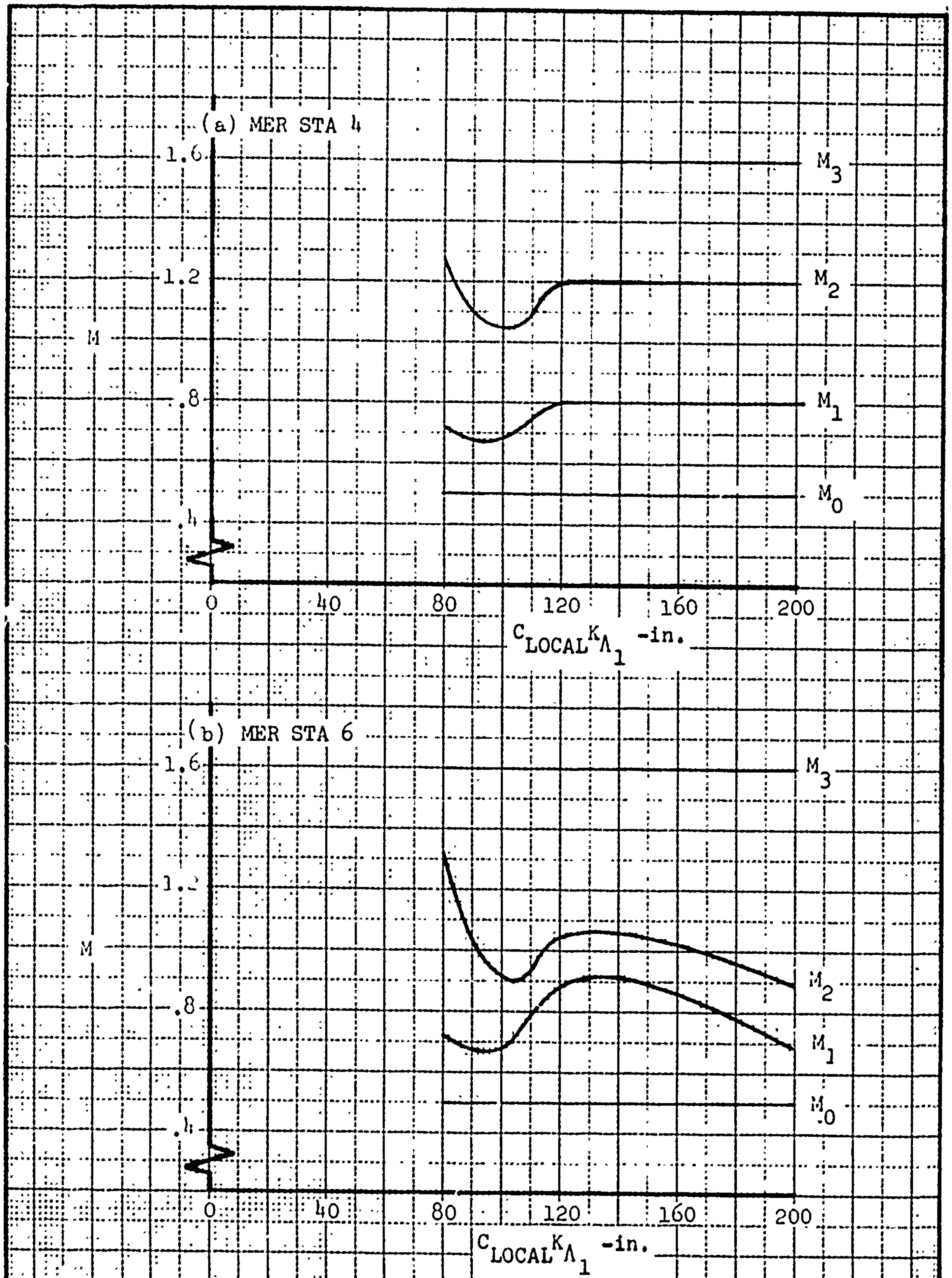


Figure 805. Rolling Moment Intercept - Mach Number Break Points for MER Stations 4 and 6

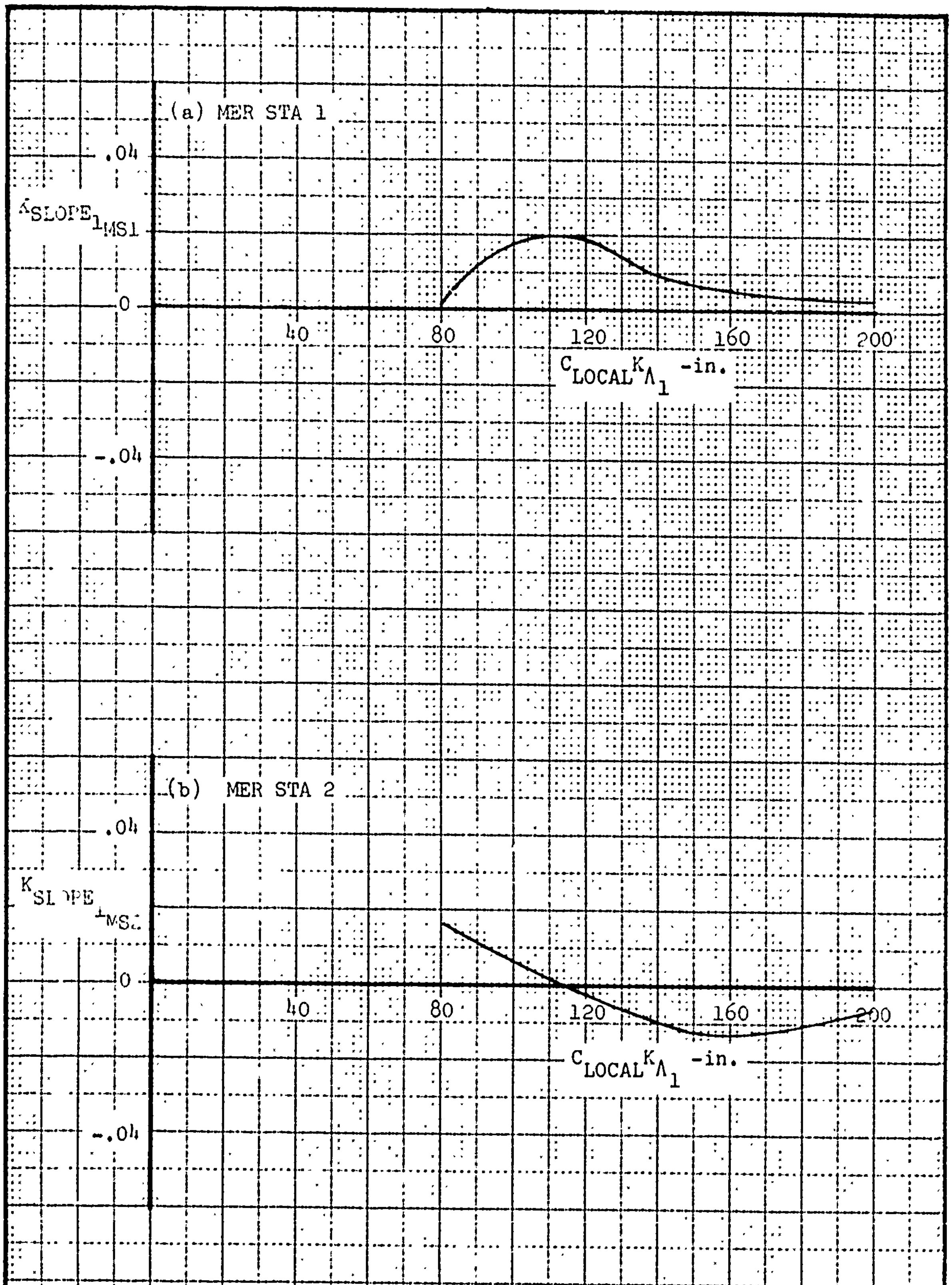


Figure 806. Rolling Moment Intercept - K_{SLOPE_1} for MER Stations 1 and 2

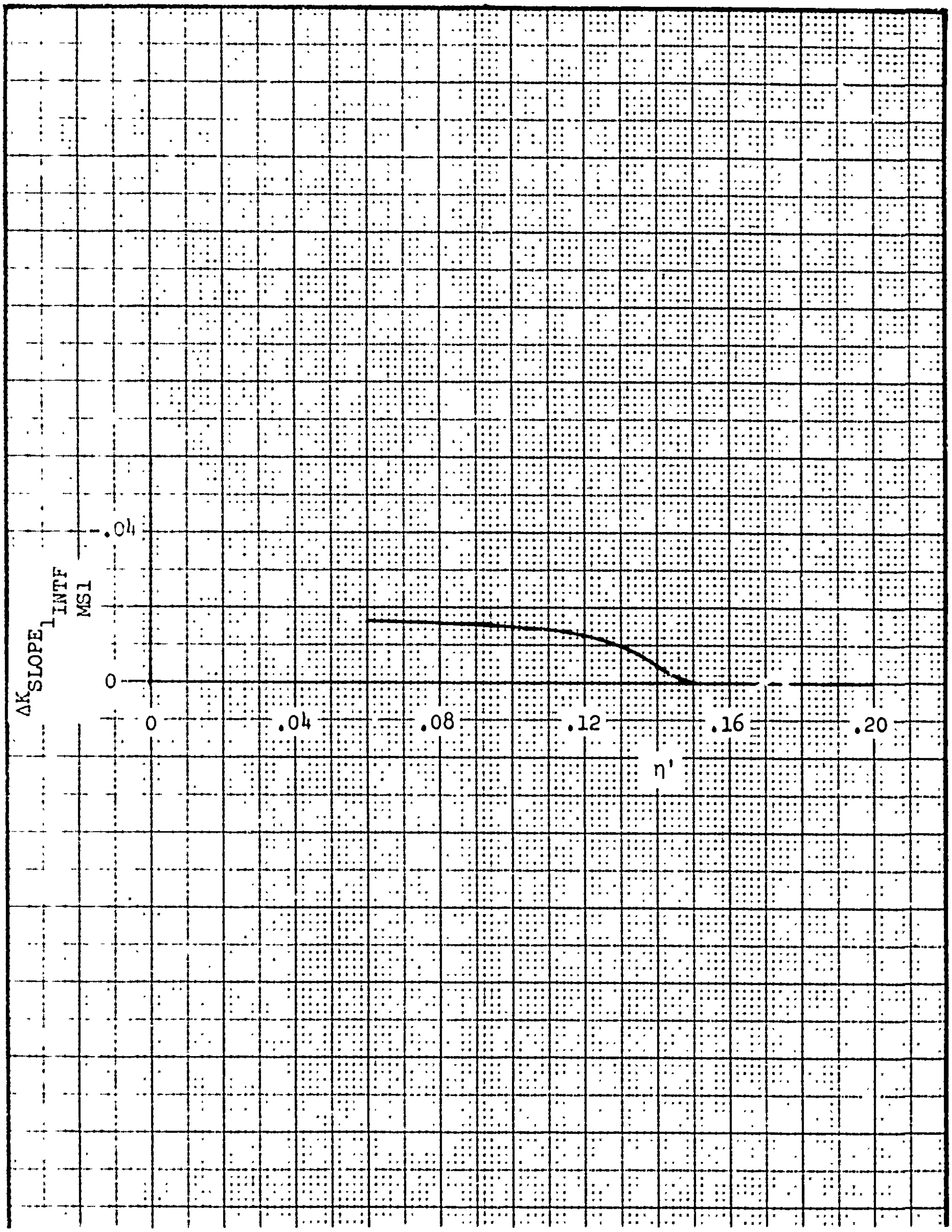


Figure 807. Rolling Moment Intercept - K_{SLOPE_1} Fuselage Interference Correction for MER Station 1

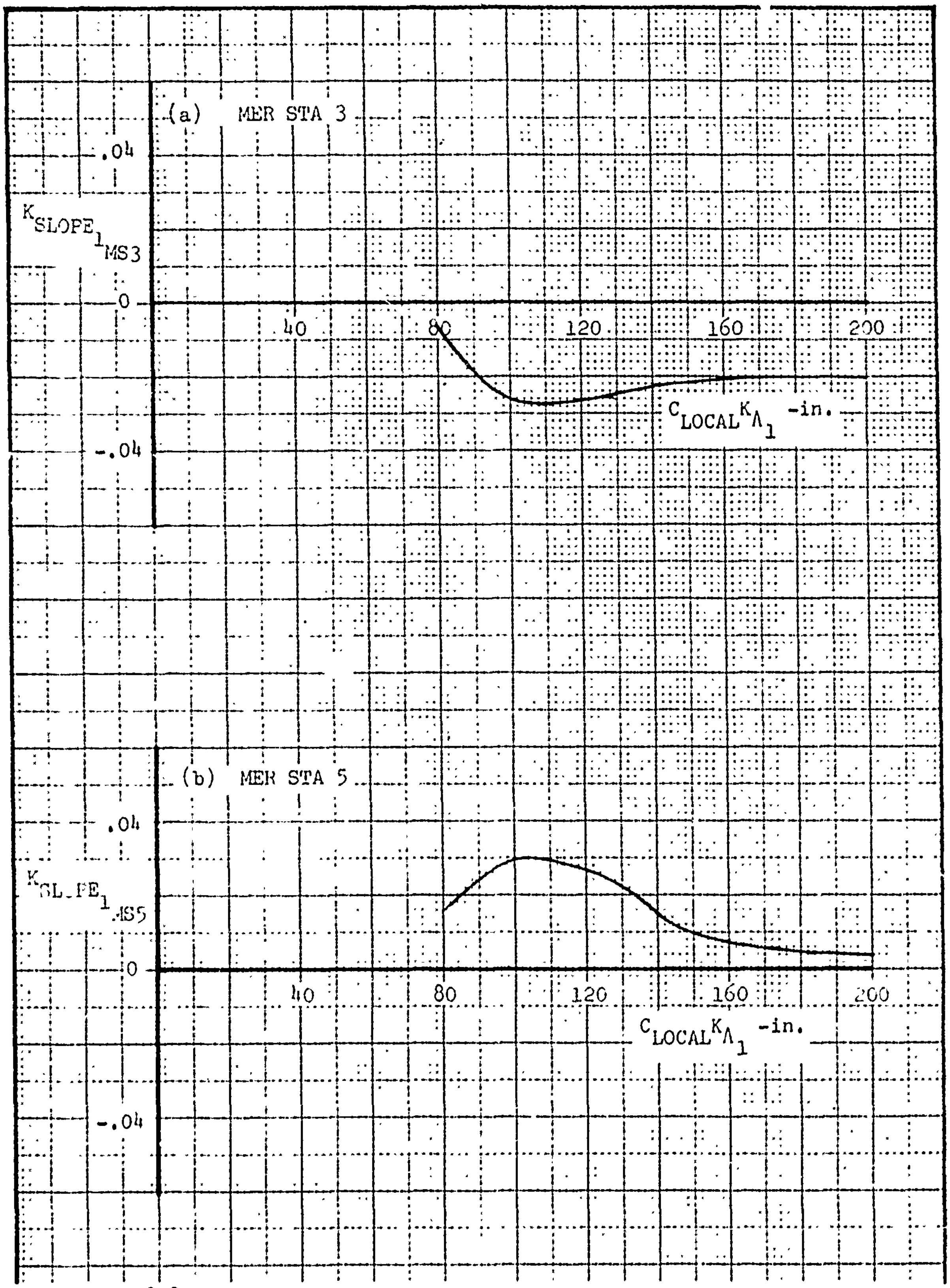


Figure 808. Rolling Moment Intercept - K_{SLOPE_1} for MER Stations 3 and

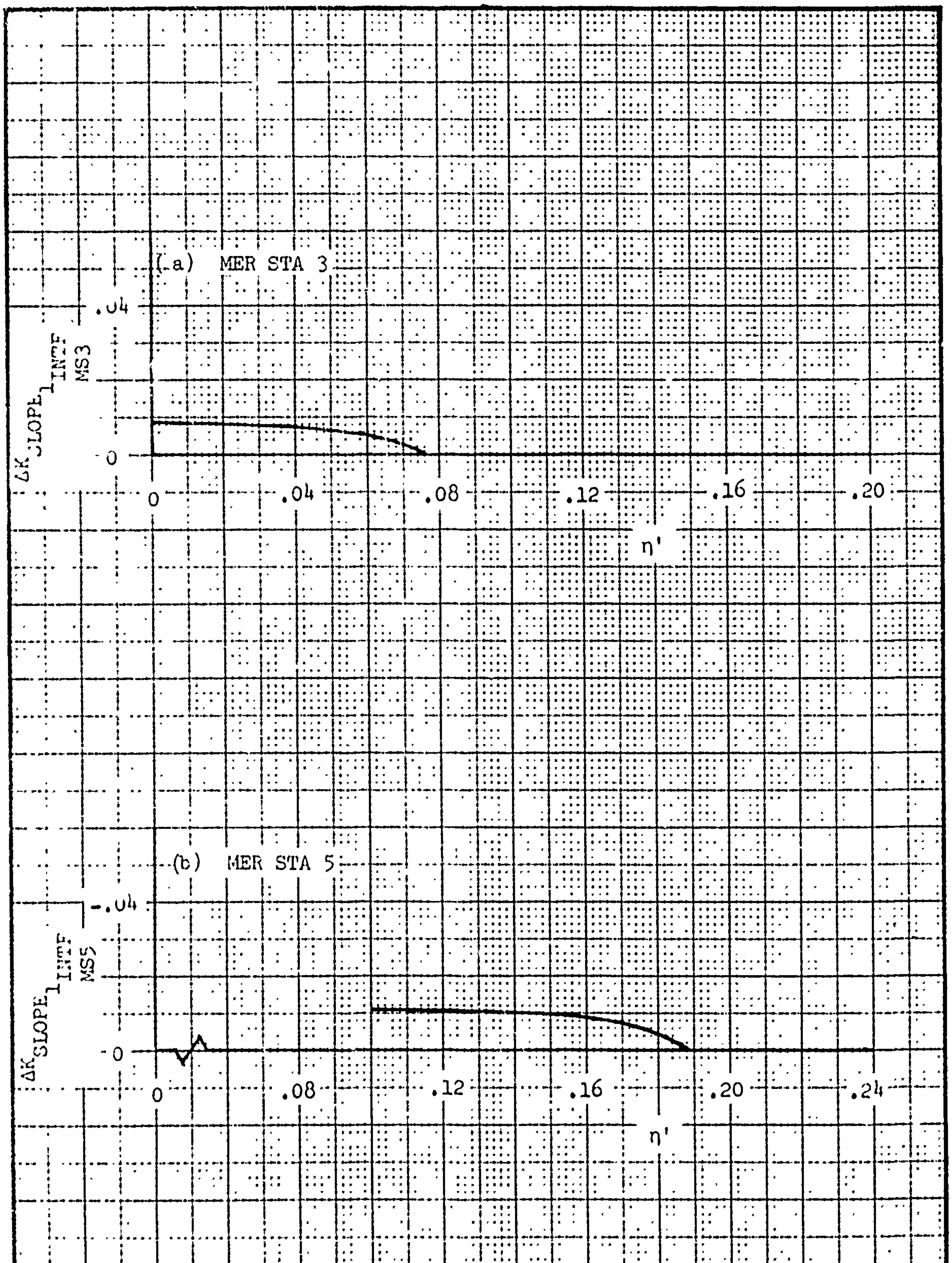


Figure 809. Rolling Moment Intercept - K_{SLOPE_1} Fuselage Interference Correction for MER Stations 3 and 5

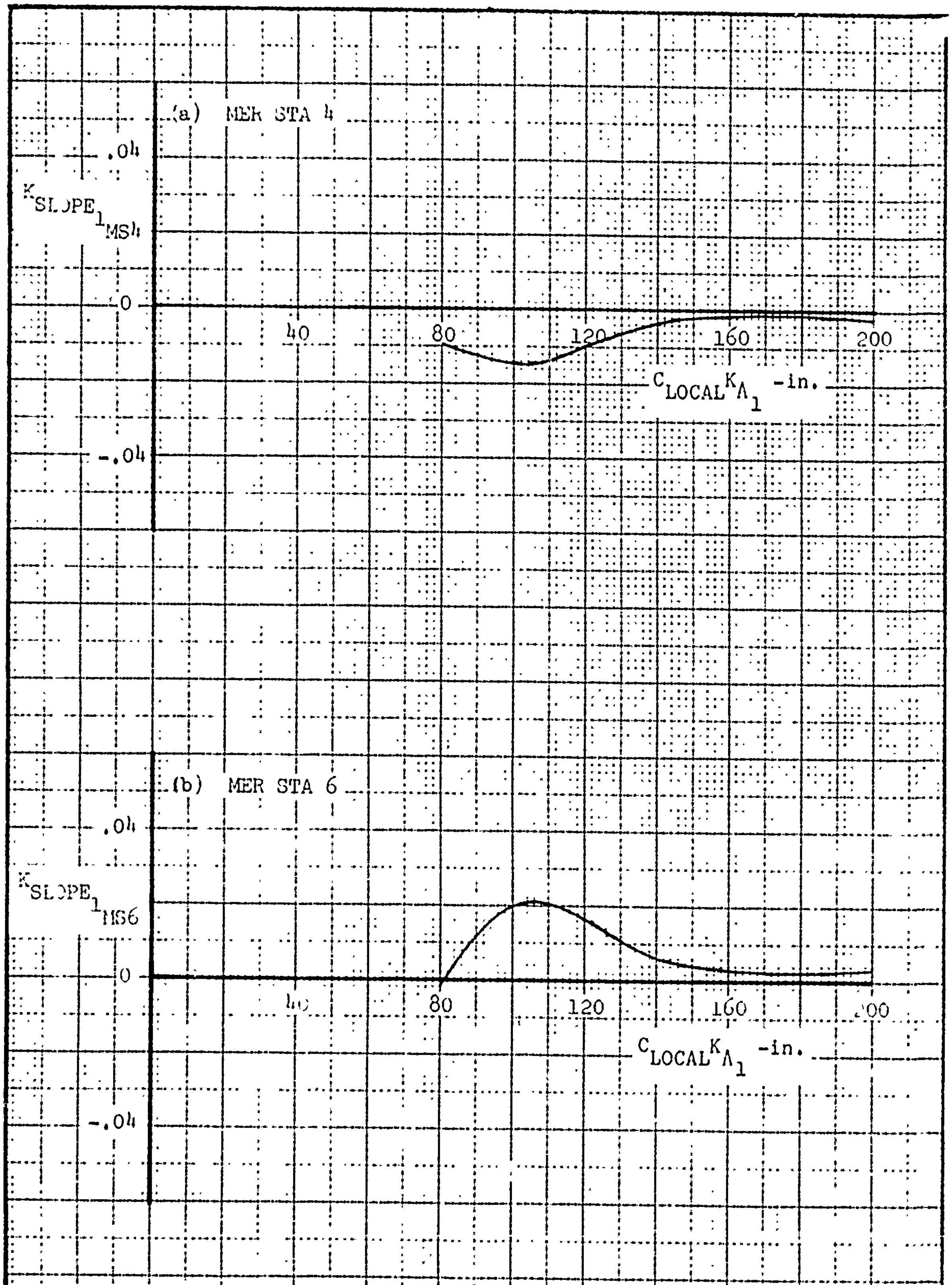


Figure 810. Rolling Moment Intercept - K_{SLOPE_1} for MER Stations 4 and 6

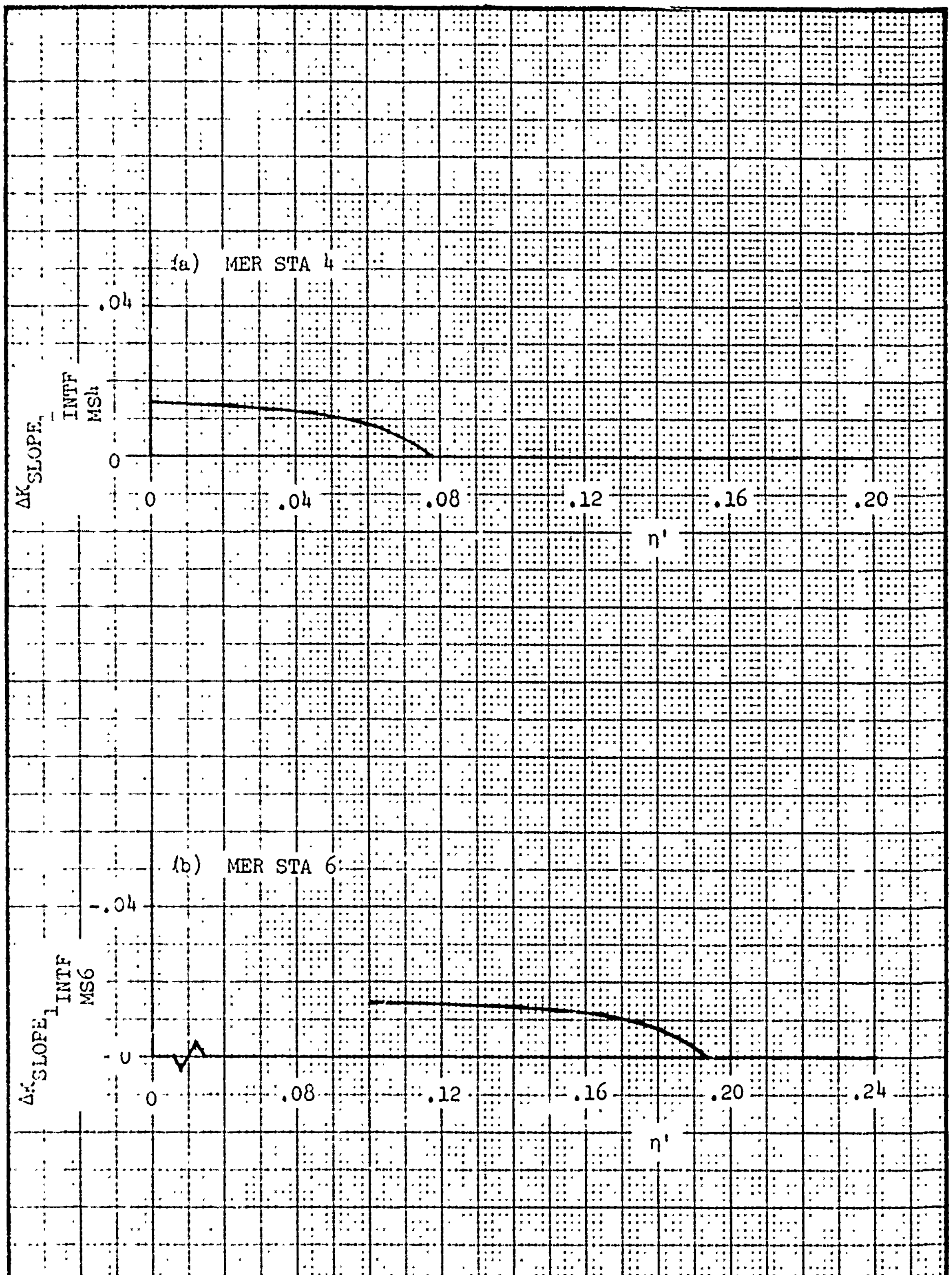


Figure 811. Rolling Moment Intercept - K_{SLOPE_1} Fuselage Interference Correction for MER Stations 4 and 6

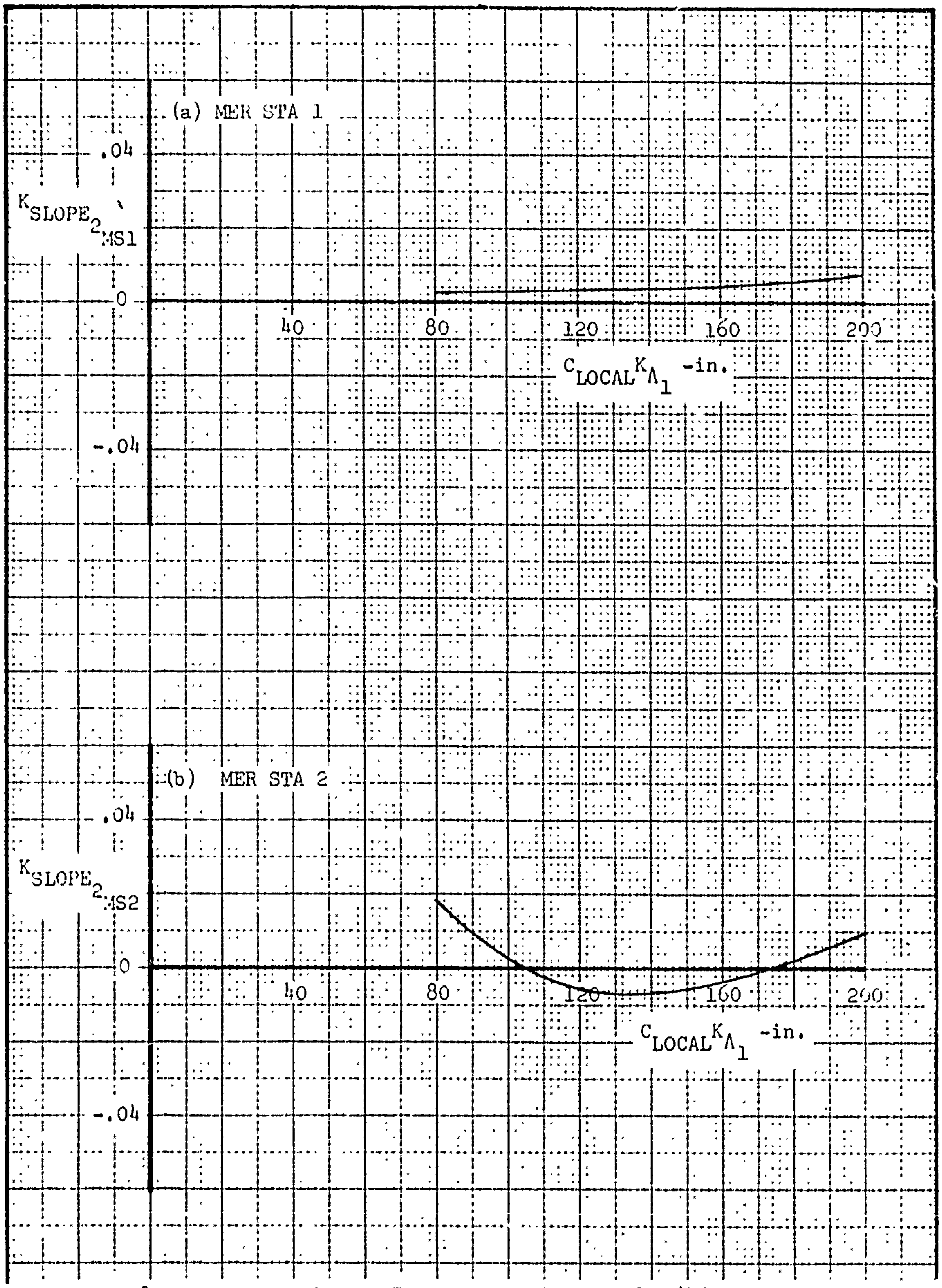


Figure 812. Rolling Moment Intercept - K_{SLOPE_2} for MER Stations 1 and 2

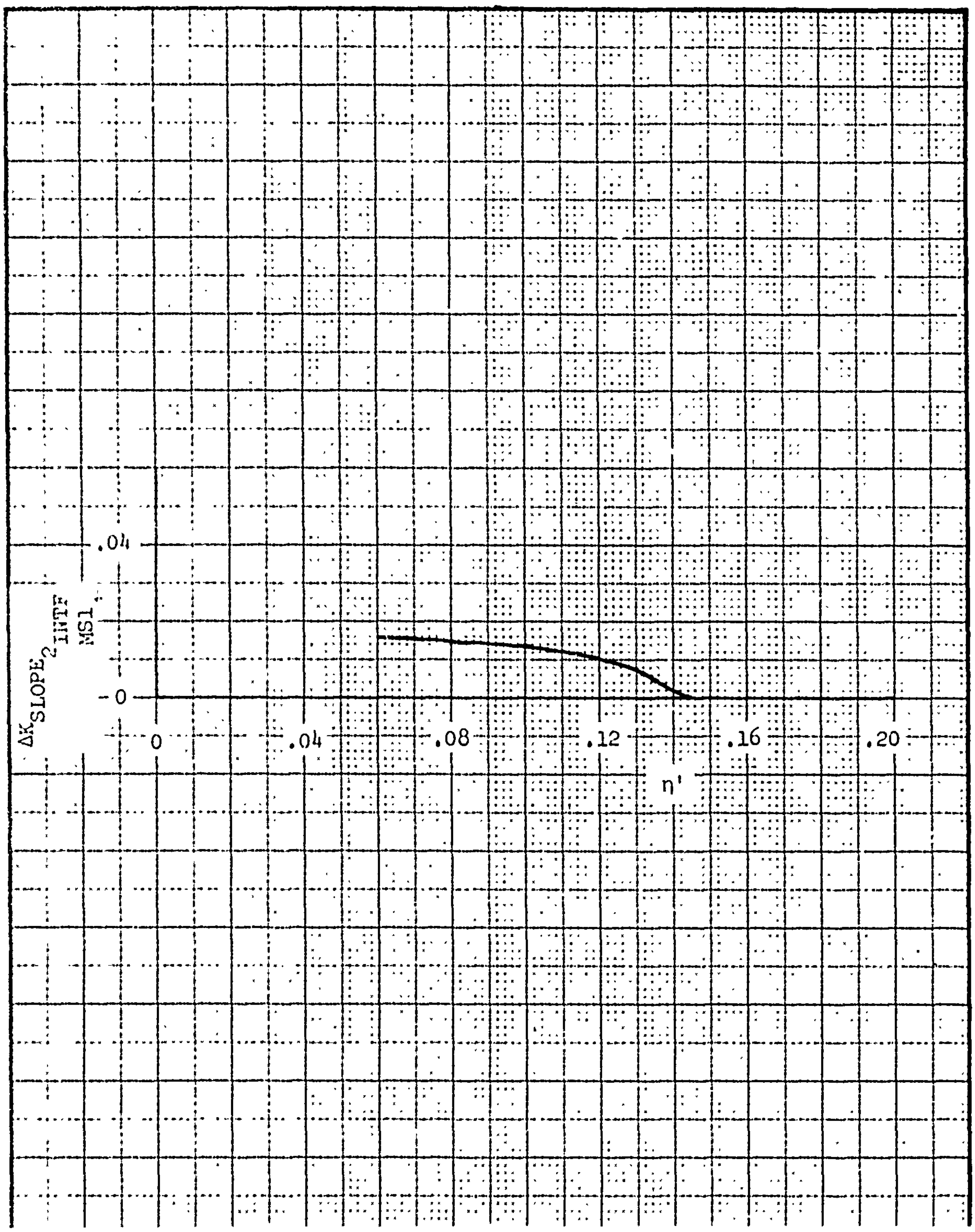


Figure 8.13. Rolling Moment Intercept - K_{SLOPE_2} Fuselage Interference Correction for MER Station 1

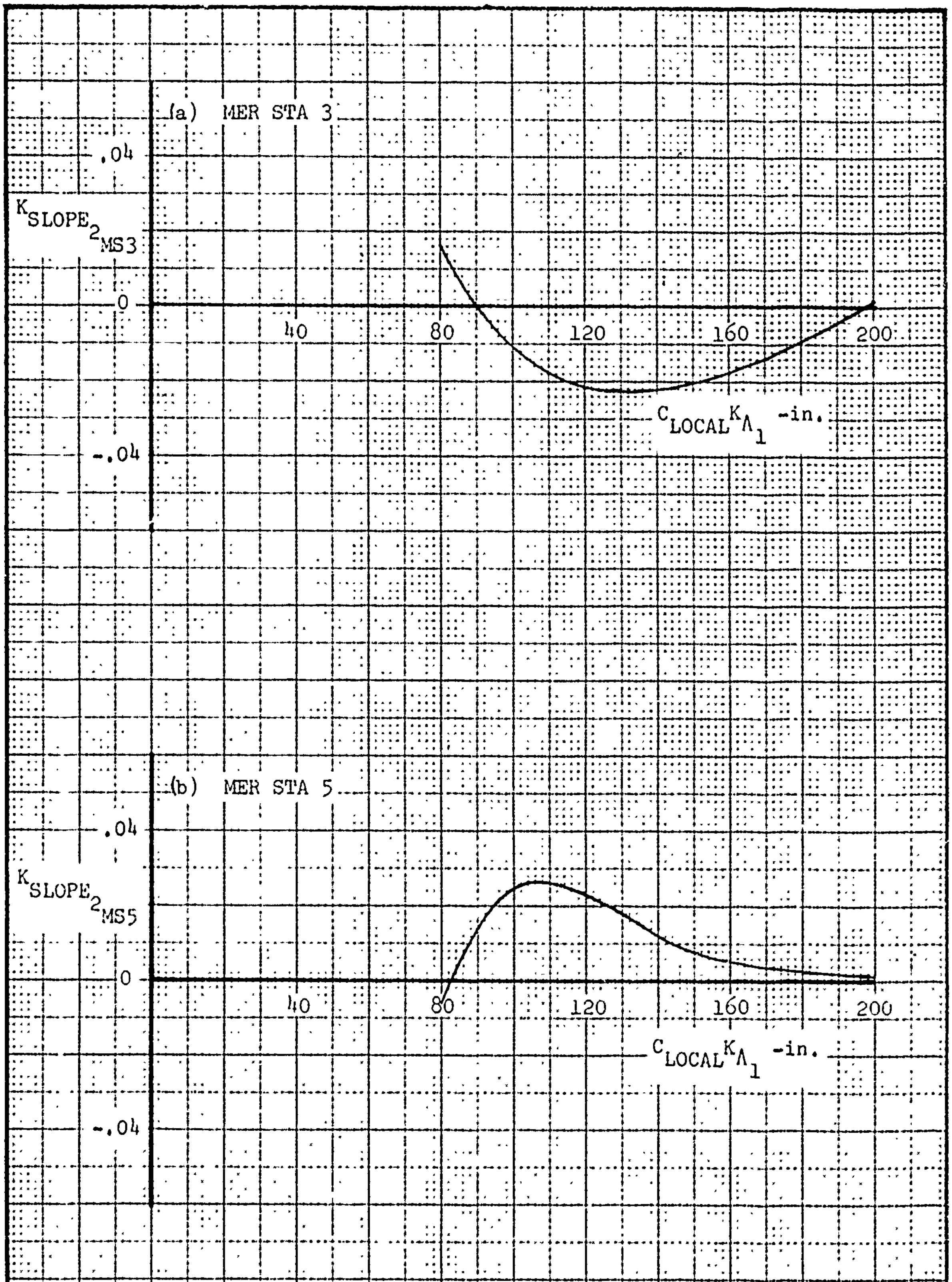


Figure 814. Rolling Moment Intercept - K_{SLOPE_2} for MER Stations and 5

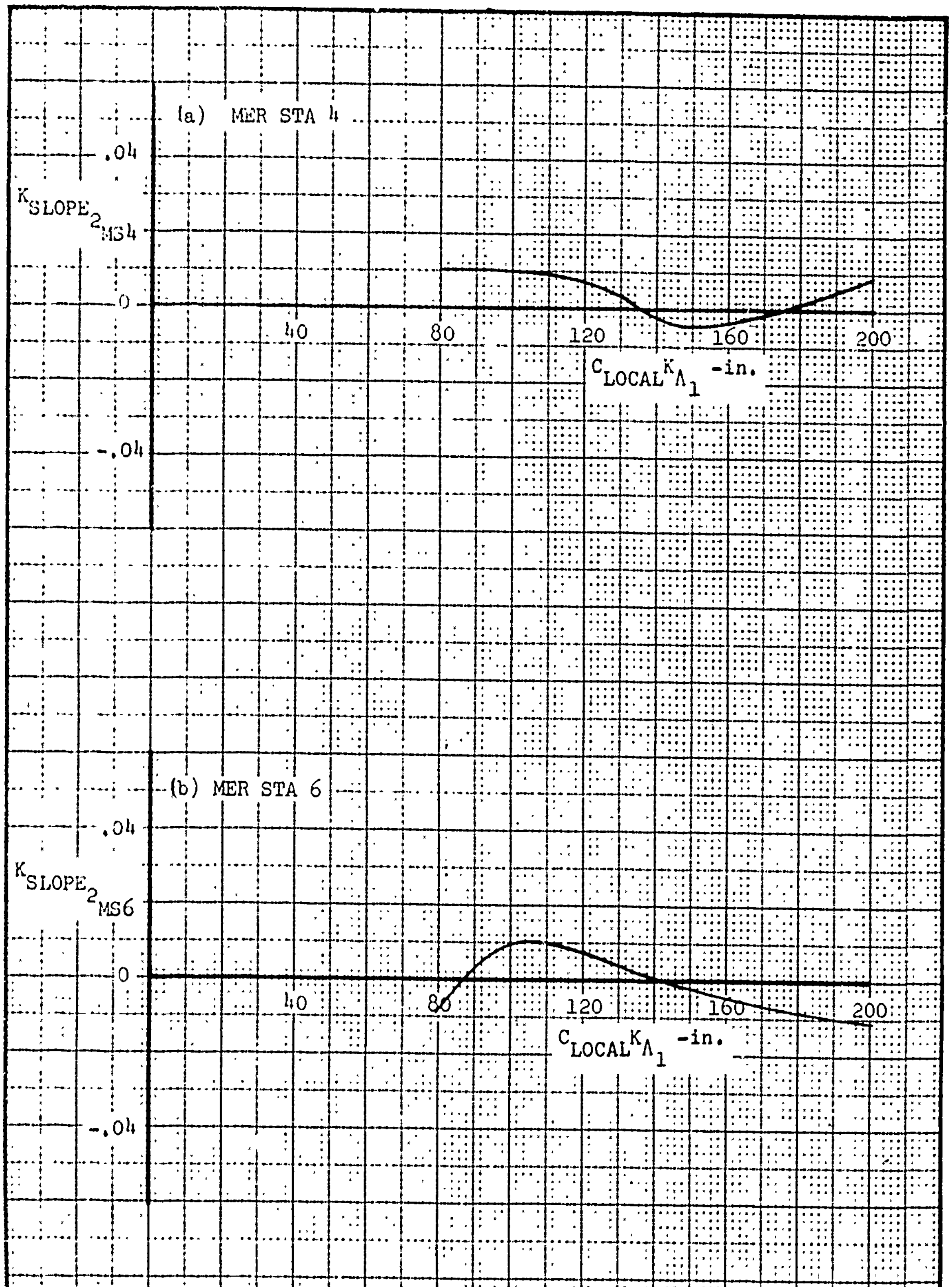


Figure 815. Rolling Moment Intercept - K_{SLOPE_2} for MER Stations 4 and 6

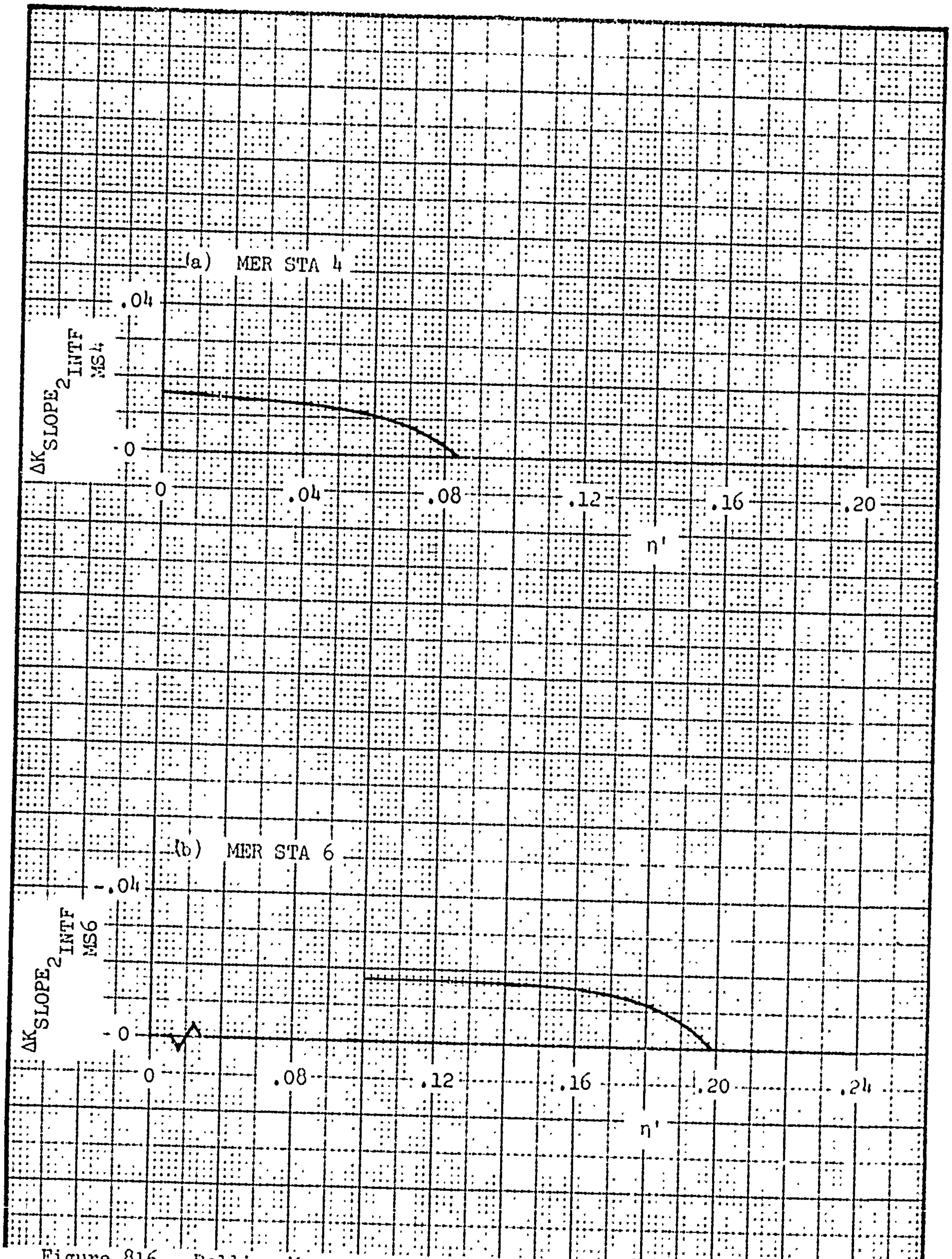


Figure 816. Rolling Moment Intercept - K_{SLOPE_2} Fuselage Interference Correction for MER Stations 4 and 6

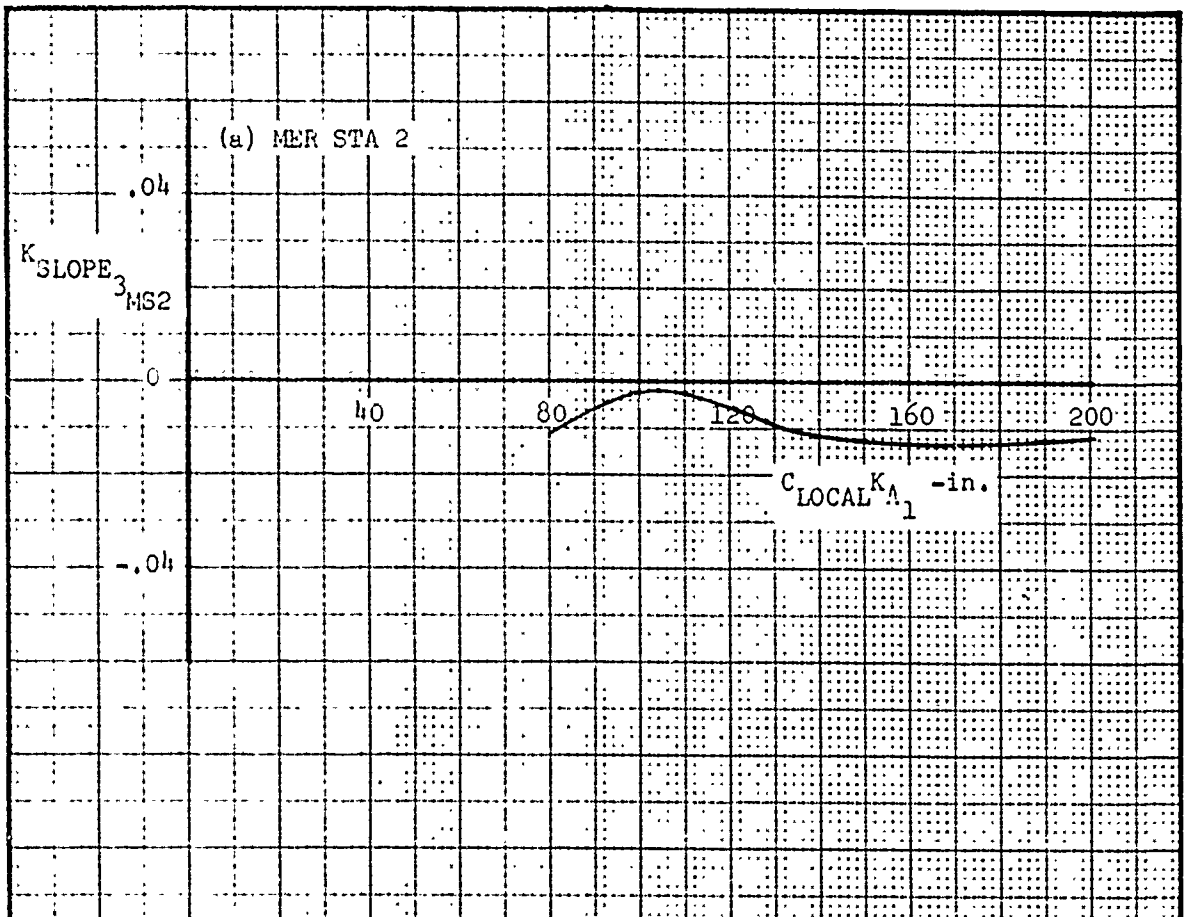


Figure 817. Rolling Moment Intercept - K_{SLOPE_3} for MER Stations 2 and 3

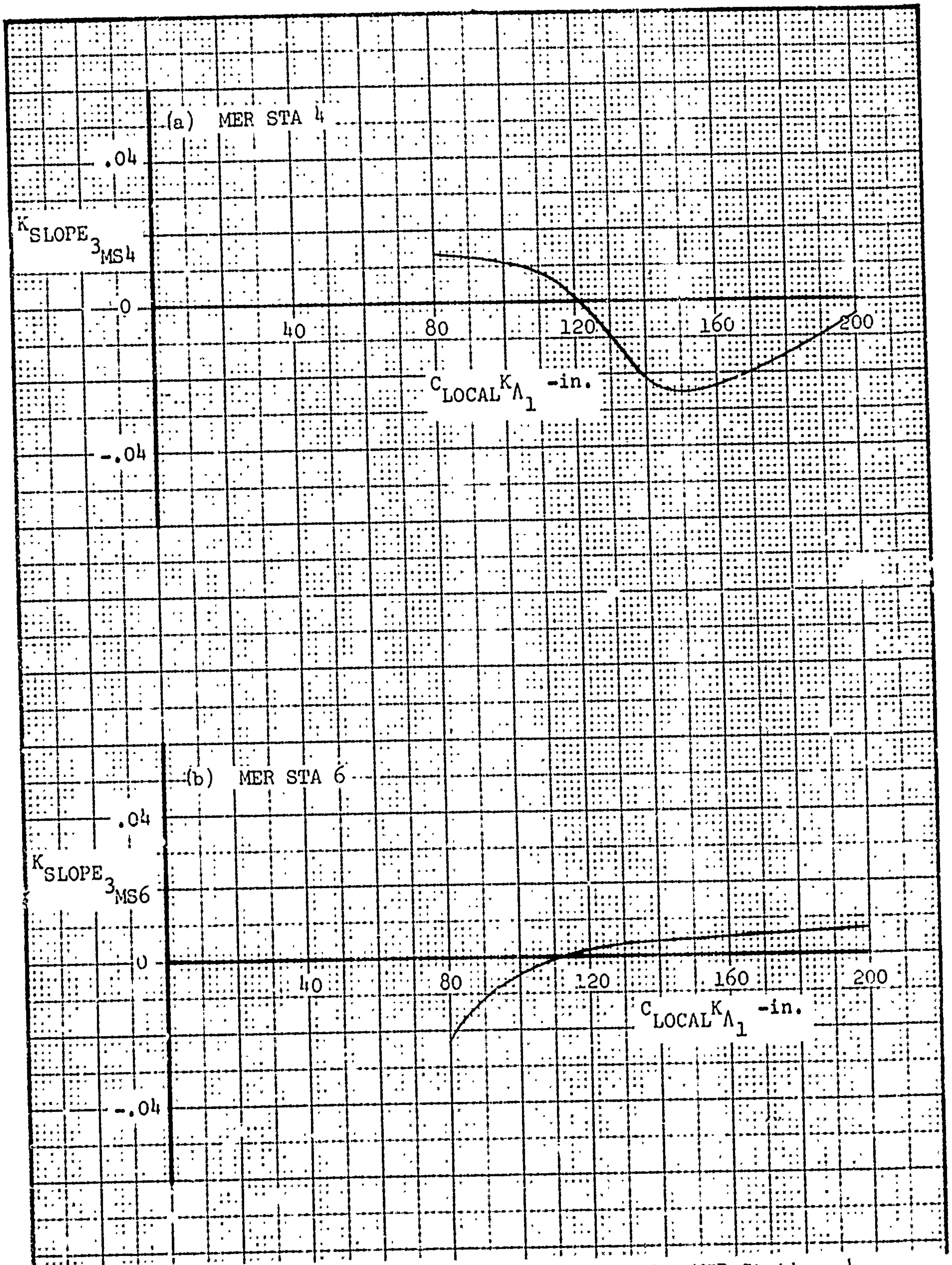


Figure 818. Rolling Moment Intercept - K_{SLOPE_3} for MER Stations 4 and 6

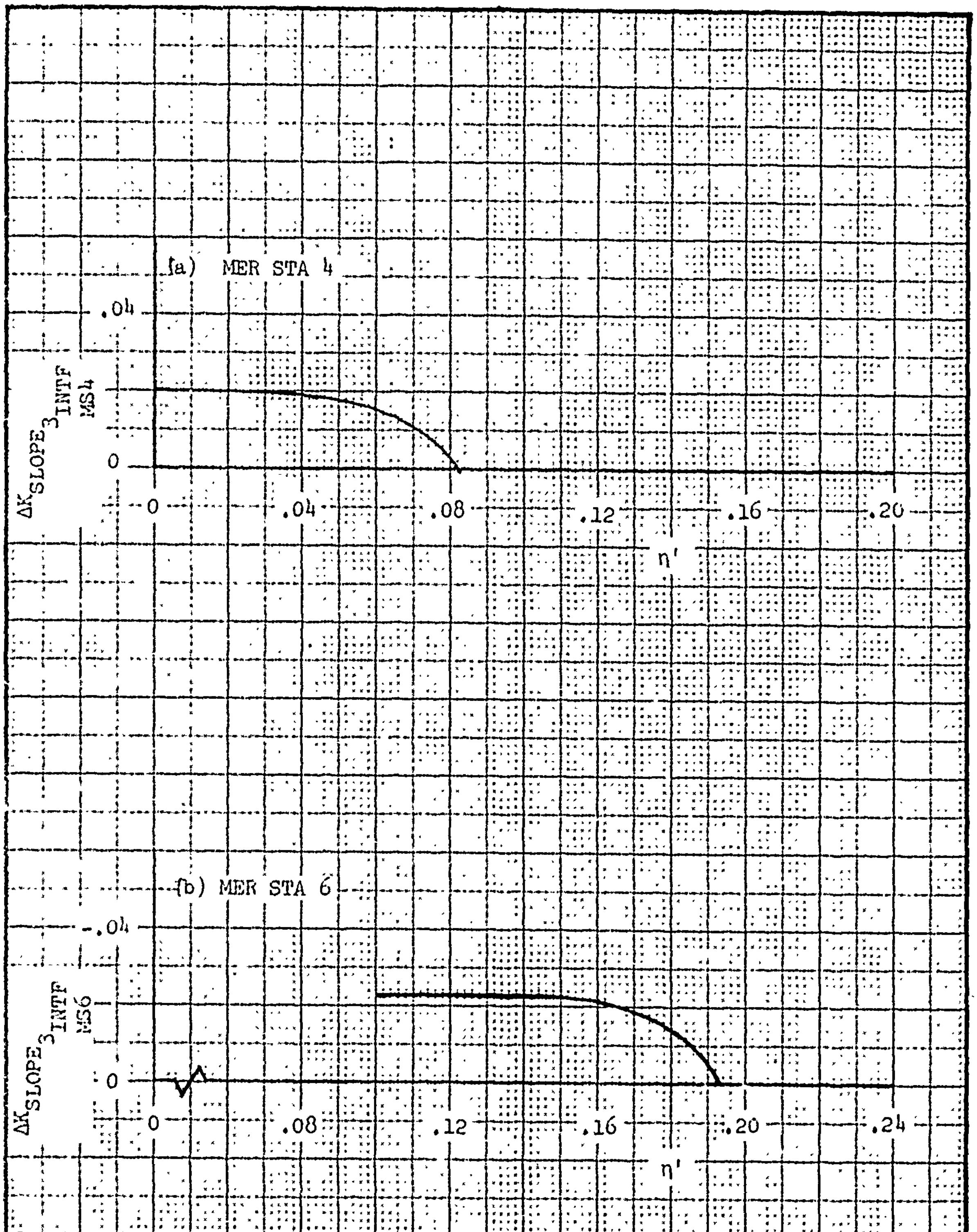


Figure 819. Rolling Moment Intercept - K_{SLOPE_3} Fuselage Interference Correction for MER Stations 4 and 6

4.6.2 Increment Aircraft Yaw

The captive store incremental rolling moment due to aircraft yaw is obtained as the difference between the yawed pitch polar and the zero-yaw pitch polar data as outlined in Section III. The incremental rolling moment slope, $\Delta\left(\frac{RM}{q}\right)_\alpha$, and intercept, $\Delta\left(\frac{RM}{q}\right)_{\alpha=0}$, thus obtained are linear with aircraft yaw angle; therefore, the incremental slope and intercept equations are derived and presented per degree of store yaw angle, β. The incremental airloads due to aircraft yaw are referenced to the coordinate system presented in Subsection 2.3.1.1.

To compute the incremental rolling moment slope, $\Delta\left(\frac{RM}{q}\right)_\alpha$, the following equation is used.

$$\Delta\left(\frac{RM}{q}\right)_\alpha = \Delta\left(\frac{RM}{q}\right)_{\alpha_\beta} \cdot \beta$$

where:

$\Delta\left(\frac{RM}{q}\right)_{\alpha_\beta}$ - Incremental rolling moment slope per degree β as obtained by the methods presented in the following subsections, $\frac{ft^3}{deg^2}$.

β - Store yaw angle, deg., equal to $+\Psi_{A/C}$ for right wing store installations or $-\Psi_{A/C}$ for left wing store installations.

The equation and procedure for computing the incremental rolling moment intercept, $\Delta\left(\frac{RM}{q}\right)_{\alpha=0}$, due to aircraft yaw is similar to the above presentation for incremental yawing moment slope.

For the reasons discussed in Section IV, a rolling moment scaling factor appears in the incremental rolling moment equations of the following sections. The rolling moment scaling factor is defined by the following expression.

$$K_{SCALE_{RM}} = 0.3825 \text{ FIN AREA, } ft^3.$$

where:

FIN AREA - Total planform area of all stores fins, ft^2.

4.6.2.1 Slope Prediction

The incremental rolling moment slope prediction is divided into two sections, fuselage centerline-mounted stores and wing-mounted stores. The technique presented in this section covers the Mach number range 0.5 to 1.6.

FUSELAGE CENTERLINE-MOUNTED STORES

MER STATIONS 1-6 (MS1-6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{\beta_{\mathbb{E}}}} = \Delta C_{\ell_{\alpha_{\beta_{\mathbb{E}}}}}_{MS1-6} \cdot K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\alpha_{\beta_{C_L}}}}$ - Incremental $C_{\ell_{\alpha_\beta}}$ presented as a function of Mach number, $\frac{1}{deg^2}$.

MER STA 1 - Figure 820

MER STA 2 - Figure 821

MER STA 3 - Figure 820

MER STA 4 - Figure 821

MER STA 5 - Figure 820

MER STA 6 - Figure 821

$K_{SCALE_{RM}}$ - Defined in Subsection 4.6.2., ft^3.

WING MOUNTED STORES

MER STATIONS 1,3, and 5 (MS1,3,5):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{\beta_{MS1,3,5}}} = \left(\Delta C_{\ell_{\alpha_{\beta_{MS1,3,5}}}} + K_{\ell_{LE_A}/C} \cdot \Delta C_{\ell_{\alpha_{\beta_{\ell_{LE_A}/C_{MS1,3,5}}}}}\right) K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\alpha_\beta}}$ - Incremental C_{ℓ_α} per degree β presented as a function of wing spanwise position for Mach numbers 0.7, 0.9, 1.05, 1.2, and 1.6, $\frac{1}{deg^2}$, Table 23.

$K_{\ell_{LE_A}/C}$ - Proportioning factor based on the distance from the wing leading edge to the nose of the store on MER Station 1 measured in the wing plan view divided by the local wing chord, positive, Figure 833.

$\Delta C_{\ell_{\alpha_{\beta_{\ell_{LE_A}/C}}}}$ - Incremental C_{ℓ_α} per degree β based on ℓ_{LE_A}/C defined above and presented as a function of Mach number, $\frac{1}{deg^2}$,

MER STA 1 - Figure 834

MER STA 3 - Figure 834

MER STA 5 - Figure 834

$K_{SCALE_{RM}}$ - Defined in Subsection 4.6.2, ft^3.

MER STATIONS 2,4, and 6 (MS2,4,6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{\beta_{MS2,4,6}}} = \left(\Delta C_{\ell_{\alpha_{\beta_{MS2,4,6}}}} + K_{\frac{\ell_{LE_F}}{C}} \cdot \Delta C_{\ell_{\alpha_{\beta_{\frac{\ell_{LE_F}}{C}_{MS2,4,6}}}}}\right) K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\alpha_\beta}}$ - Incremental C_{ℓ_α} per degree β presented as a function of wing spanwise position for Mach numbers 0.7, 0.9, 1.05, 1.2 and 1.6, $\frac{1}{deg^2}$, Table 23.

$K_{\frac{\ell_{LE_F}}{C}}$ - Proportioning factor based on the distance from the wing leading edge to the nose of the store on MER Station 2 measured in the wing plan view divided by the local wing chord, positive, Figure 832.

$\Delta C_{\ell_{\alpha_{\beta_{\frac{\ell_{LE_F}}{C}}}}}$ - Incremental C_{ℓ_α} per degree β based on ℓ_{LE_F}/C defined above and presented as a function of Mach number, $\frac{1}{deg^2}$

MER STA 2 - Figure 835

MER STA 4 - Figure 835

MER STA 6 - Figure 835

$K_{SCALE_{RM}}$ - Defined in Subsection 4.6.2, ft^3.

The variation of $\Delta C_{\ell_{\alpha_\beta}}$ for MER Stations 1-6 is presented at distinct Mach numbers of 0.7, 0.9, 1.05, 1.2, and 1.6. Table 23 presented below is a guide for locating the curves for $\Delta C_{\ell_{\alpha_\beta}}$

for each MER Station at the Mach numbers indicated above. For Mach numbers between 0.5 and 0.7, use the value at M = 0.7. For Mach numbers between 0.7 and 1.6 other than those distinctly presented, linear interpolation should be used between the appropriate Mach numbers to obtain the required value for computation.

TABLE 23. INCREMENTAL ROLLING MOMENT SLOPE COEFFICIENT DUE TO YAW - FIGURE LOCATION GUIDE

$\Delta C_{\ell_{\alpha_\beta}}$	MACH NUMBER 0.7	0.9	1.05	1.2	1.6
	Figure Numbers				
MER STA 1	822	824	826	828	830
MER STA 2	823	825	827	829	831
MER STA 3	822	824	826	828	830
MER STA 4	823	825	827	829	831
MER STA 5	822	824	826	828	830
MER STA 6	823	825	827	829	831

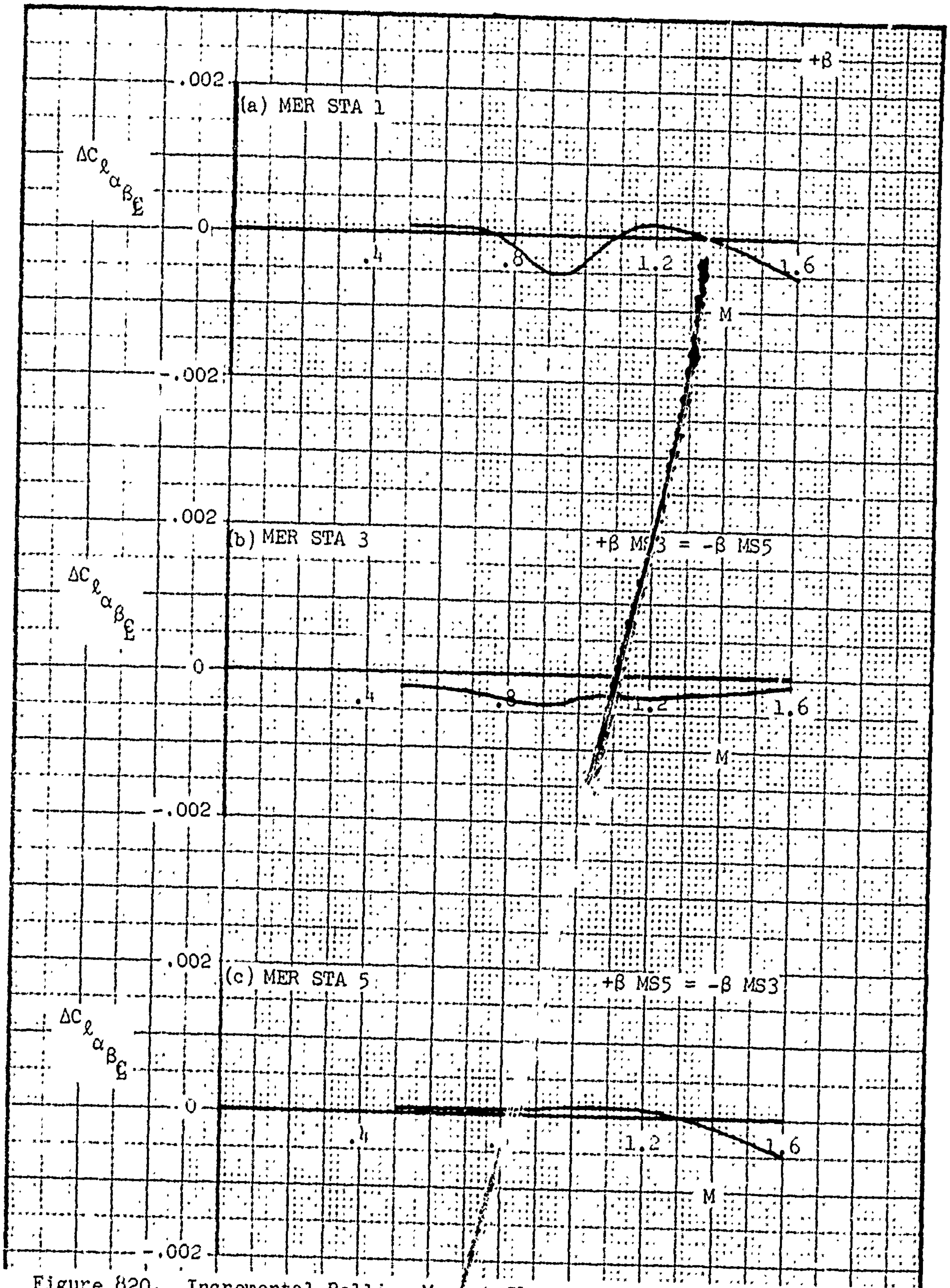


Figure 820. Incremental Rolling Moment Slope Due to Yaw - Coefficient for Stores Mounted on Fuselage Centerline, MER Stations 1,3,and 5

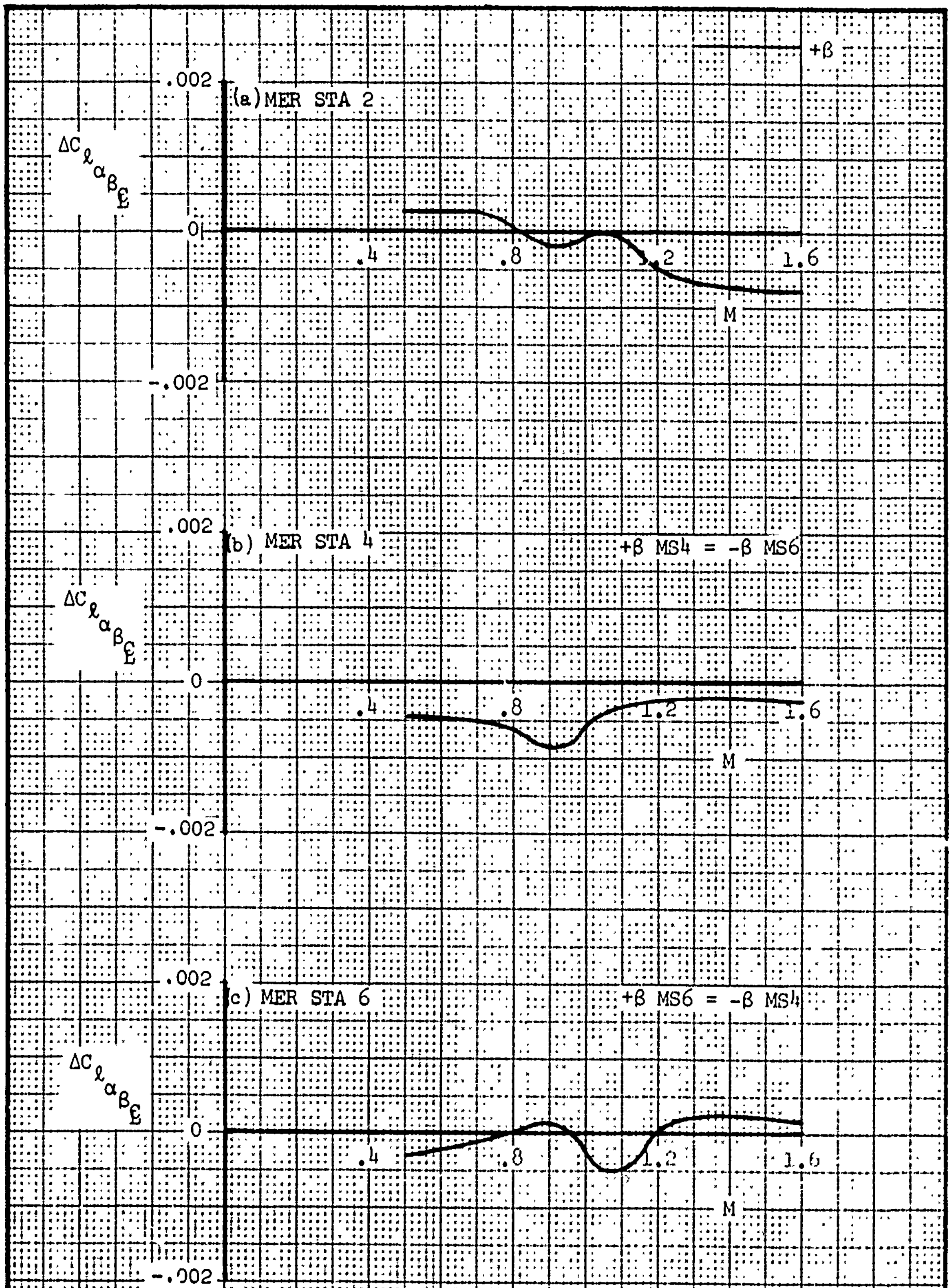


Figure 821. Incremental Rolling Moment Slope Due to Yaw - Coefficient for Stores Mounted on Fuselage Centerline, MER Stations 2,4, and 6

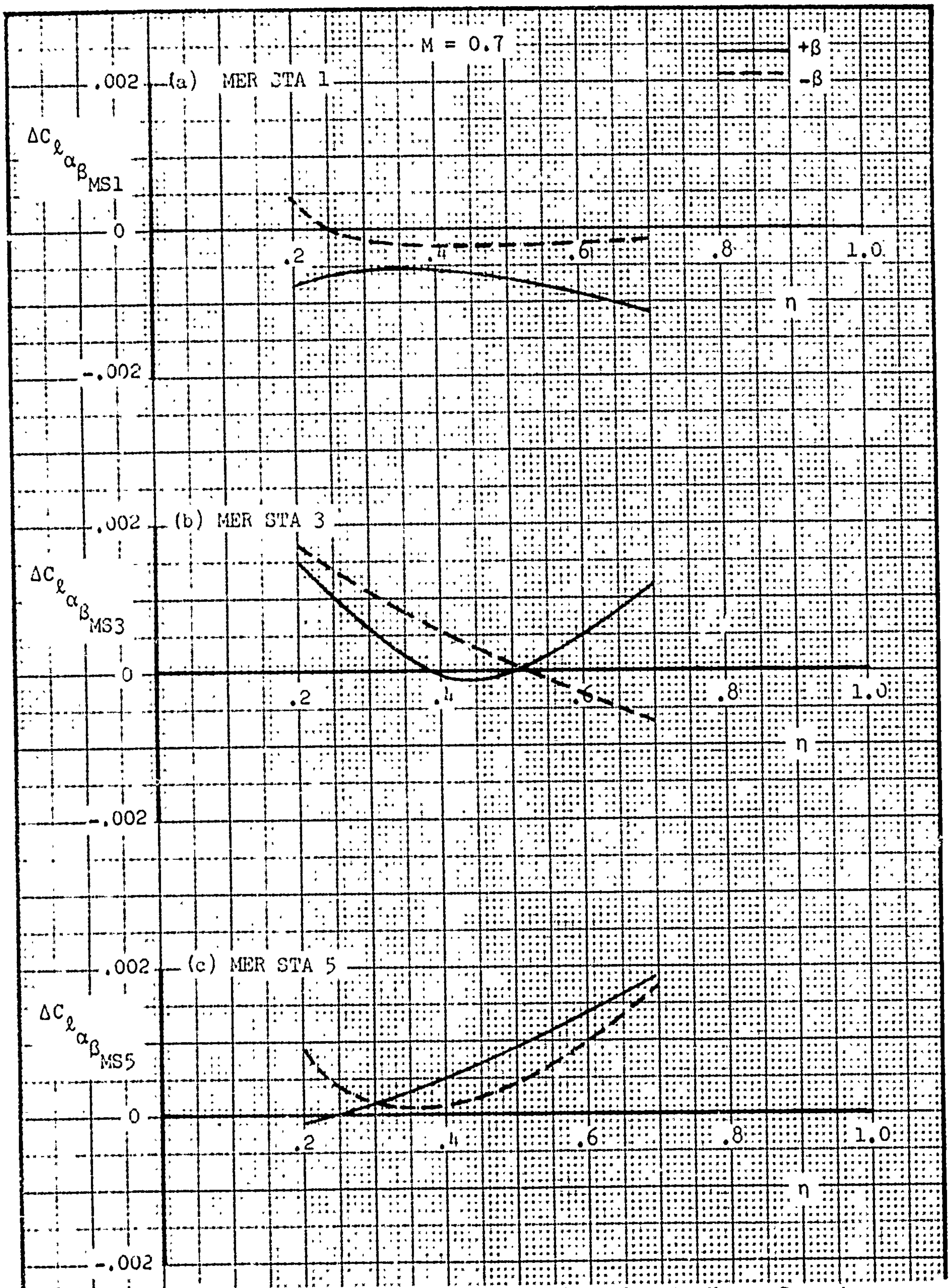


Figure 822. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=0.7 for MER Stations 1,3, and 5

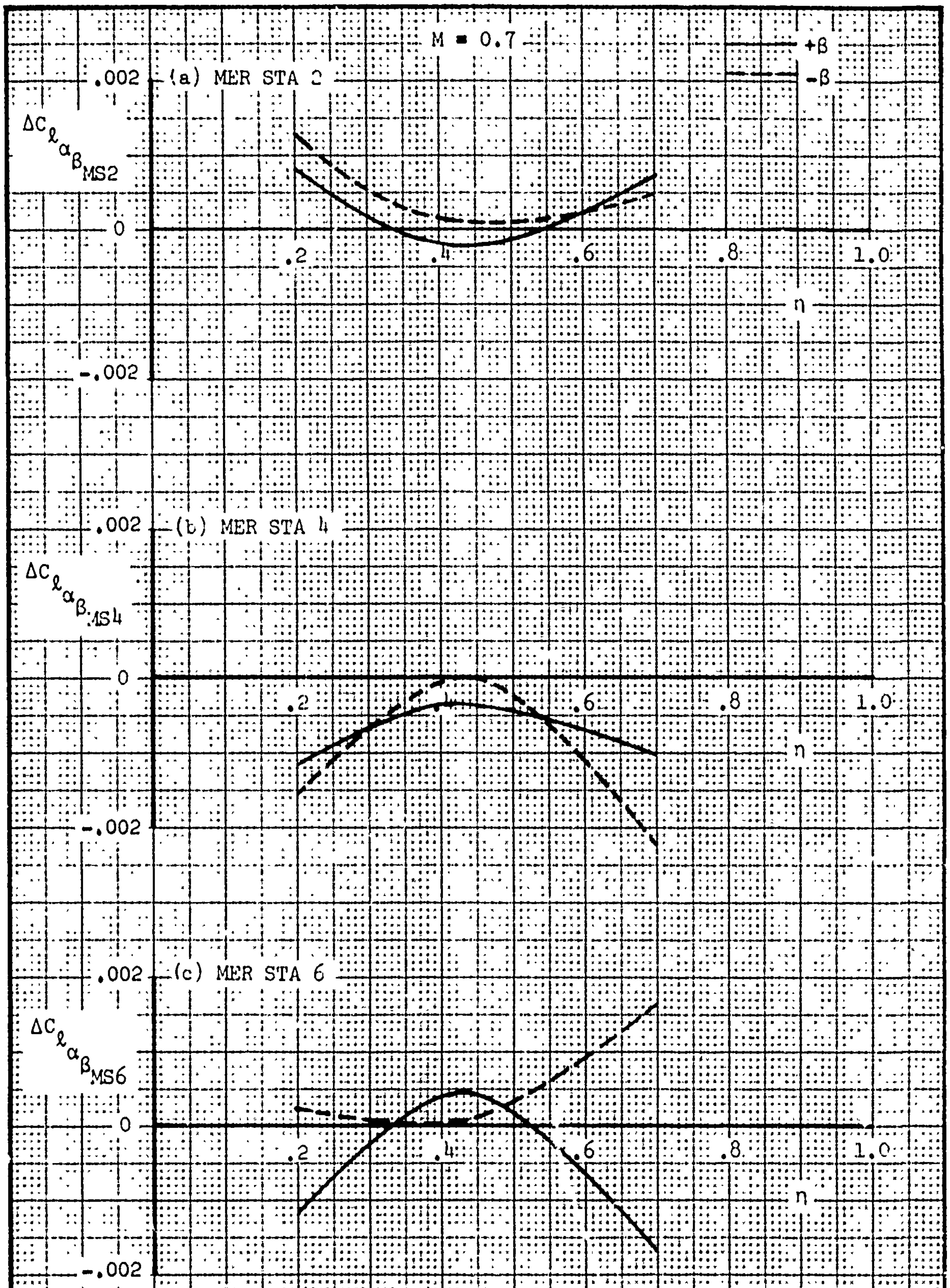


Figure 823. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=0.7 for MER Stations 2,4, and 6

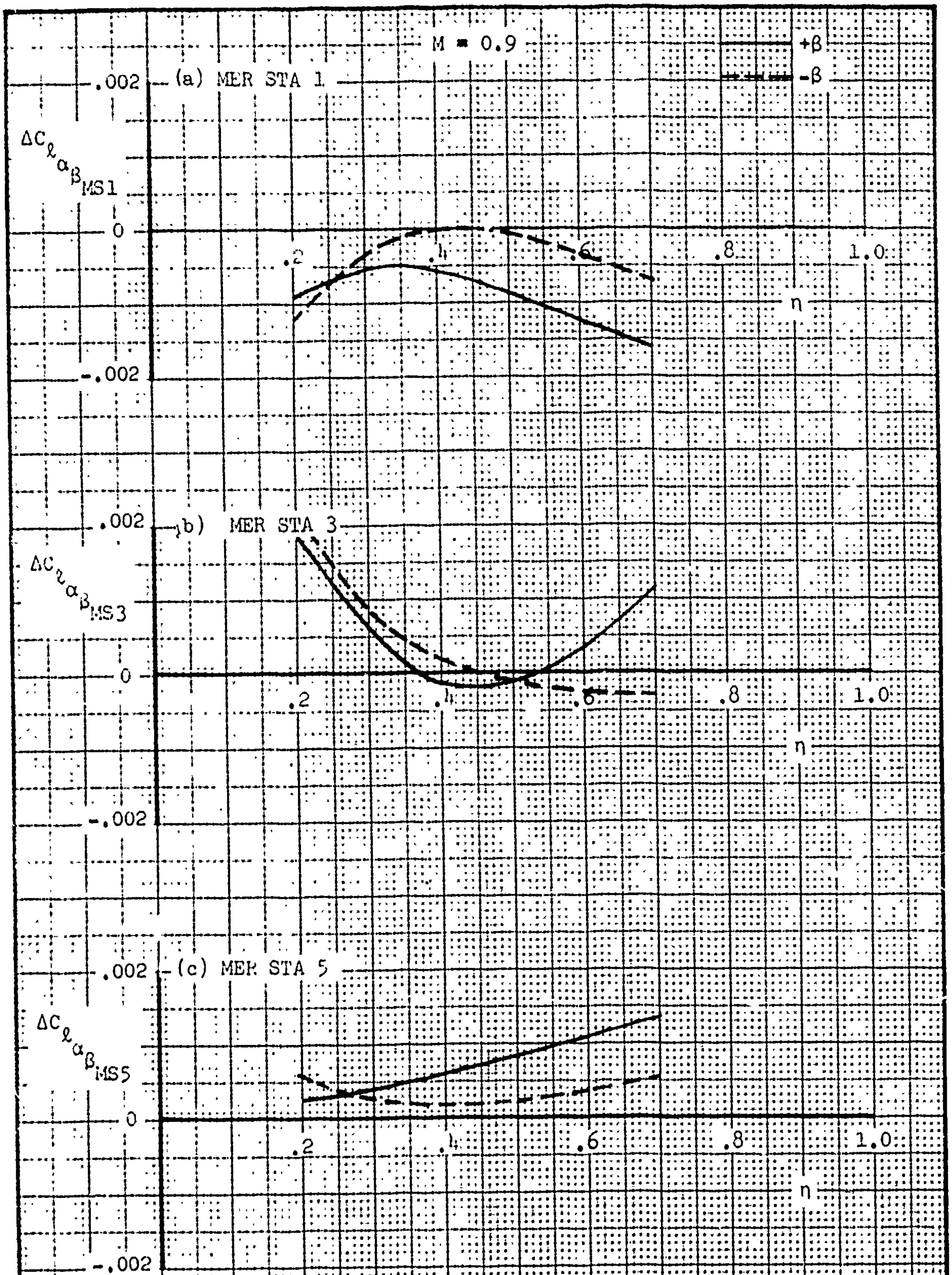


Figure 824. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=0.9 for MER Stations 1,3,and 5

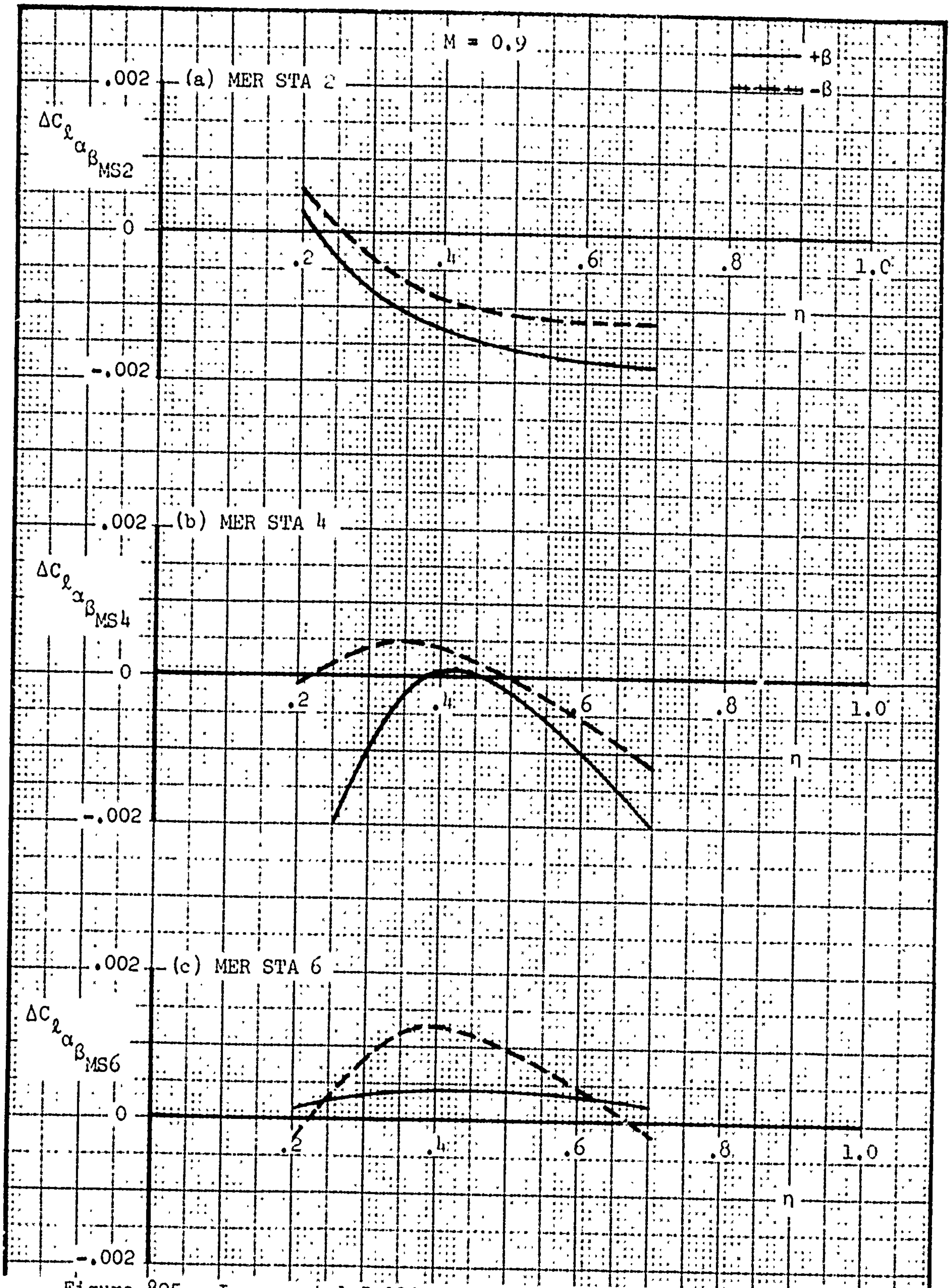


Figure 825. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=0.9 for MER Stations 2,4, and 6

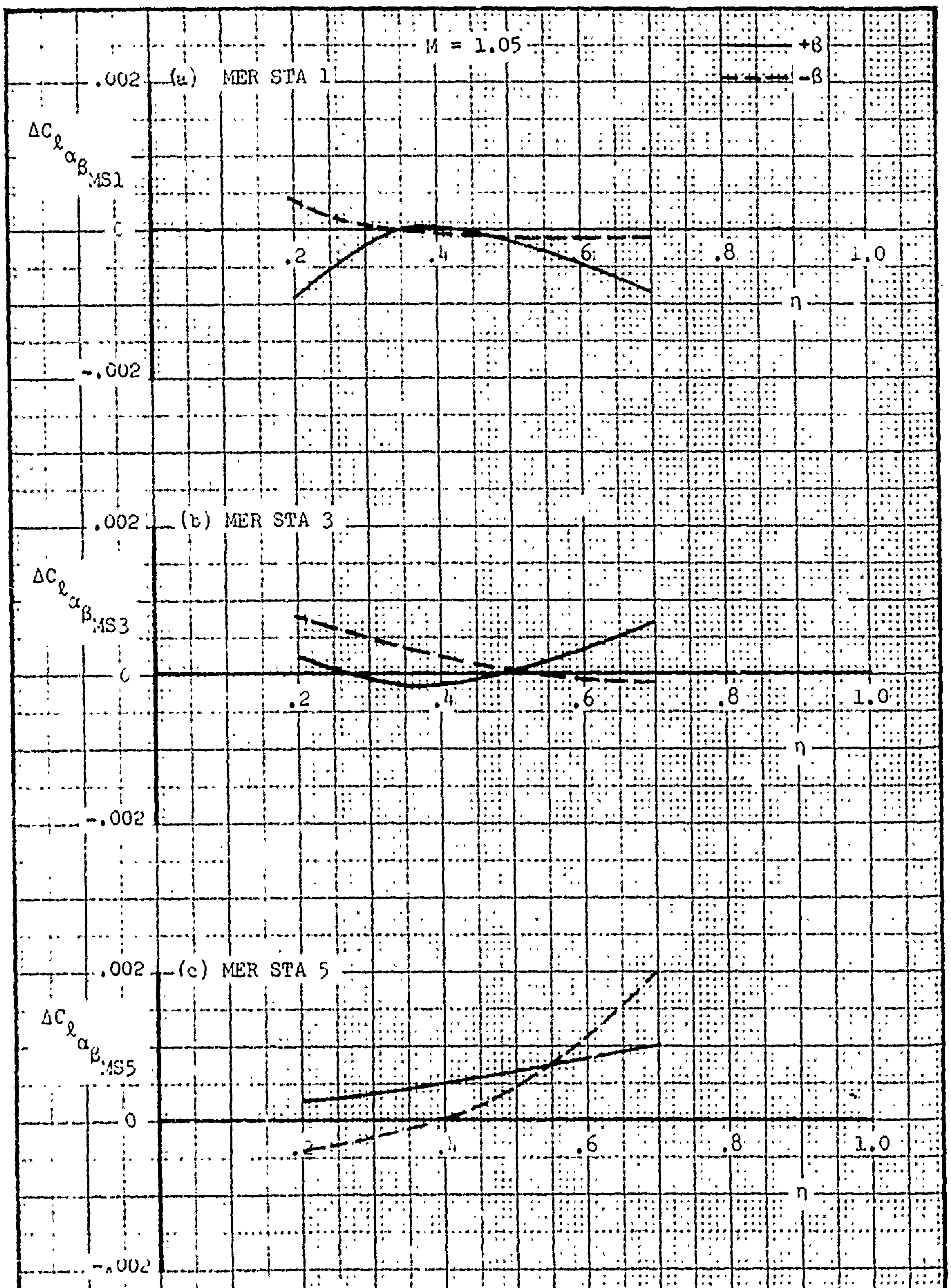


Figure 826. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=1.05 for MER Stations 1,3 and 5

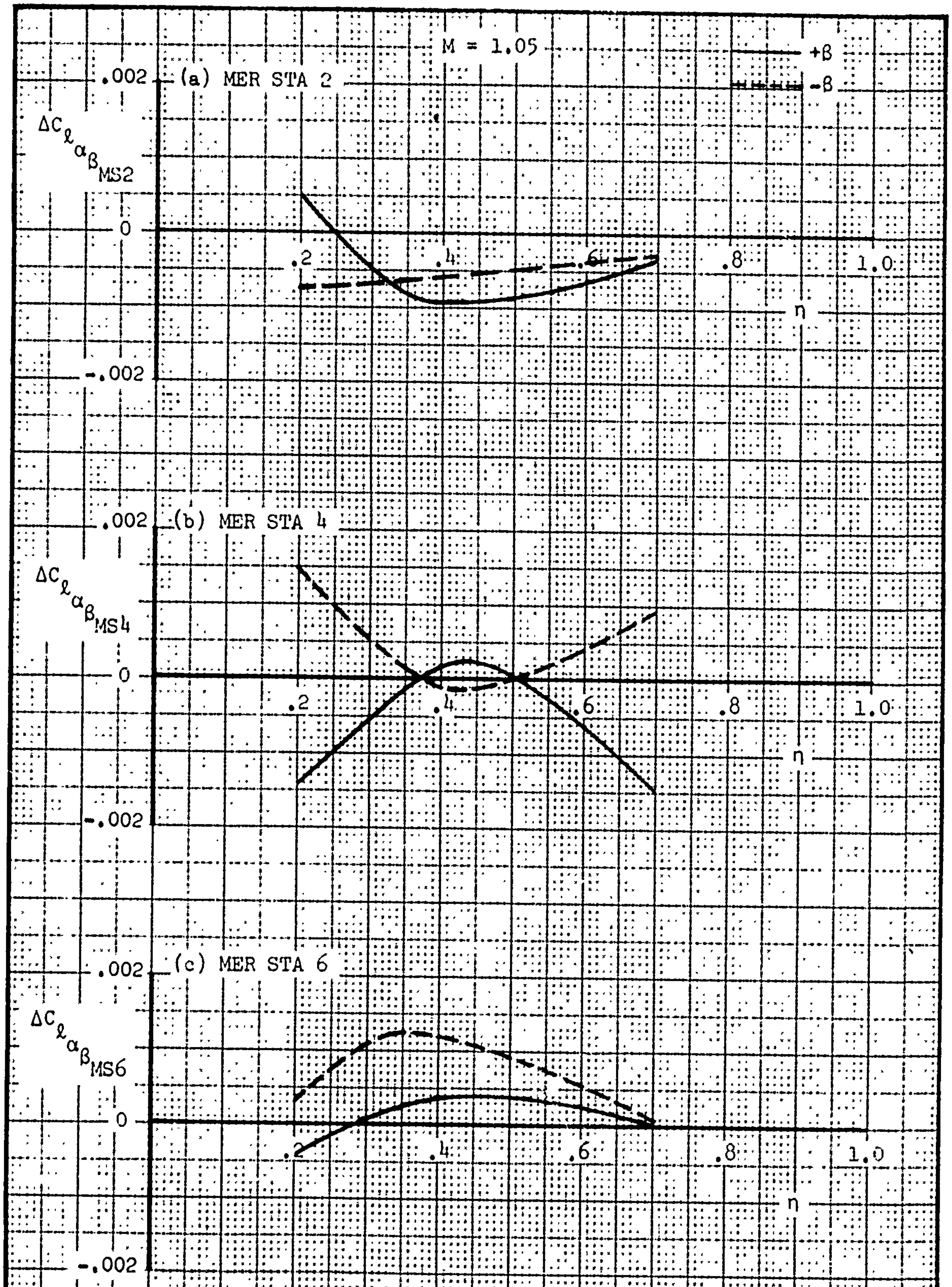


Figure 827. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=1.05 for MER Stations 2,4, and 6

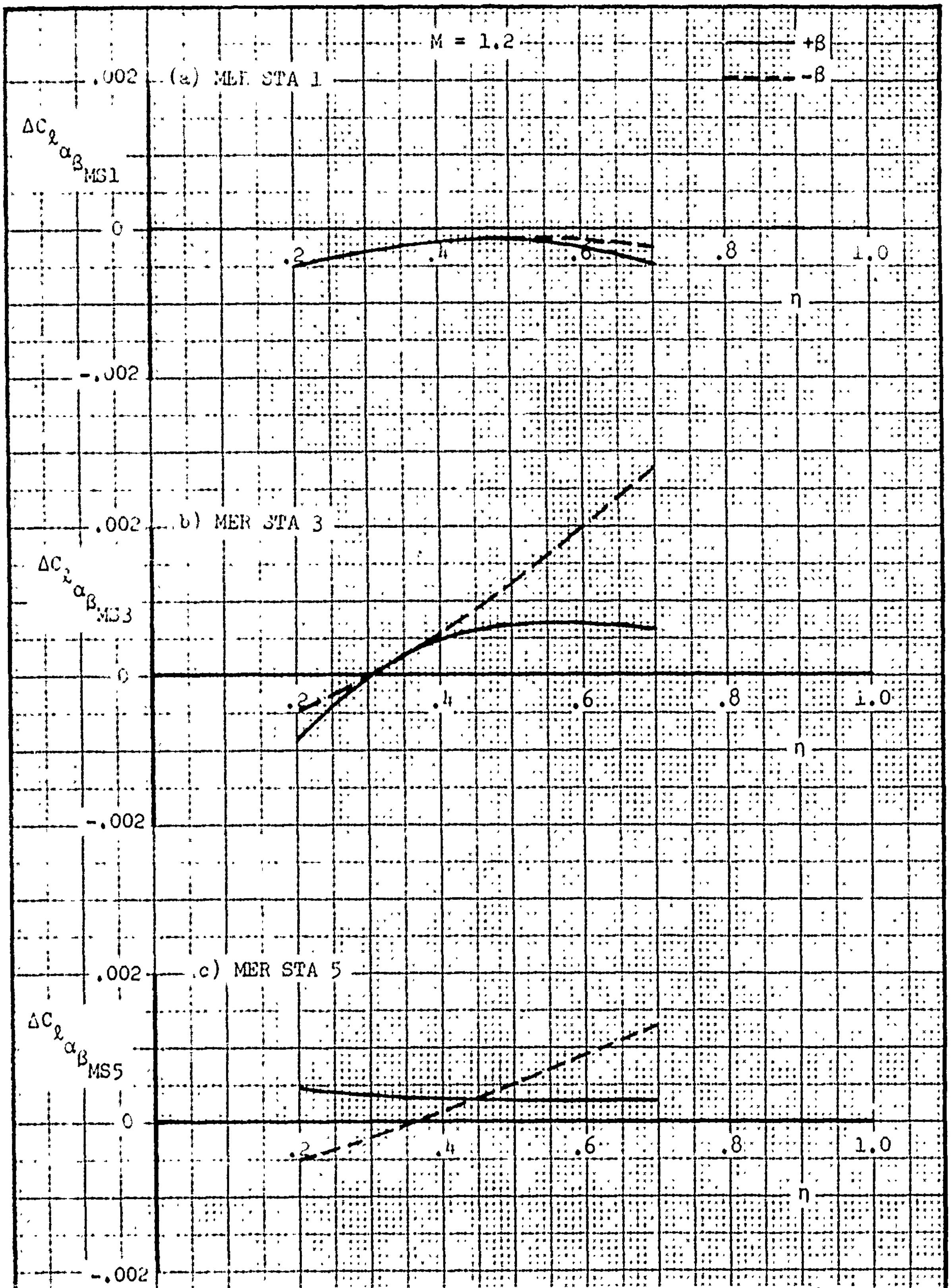


Figure 828. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=1.2 for MER Stations 1,3, and 5

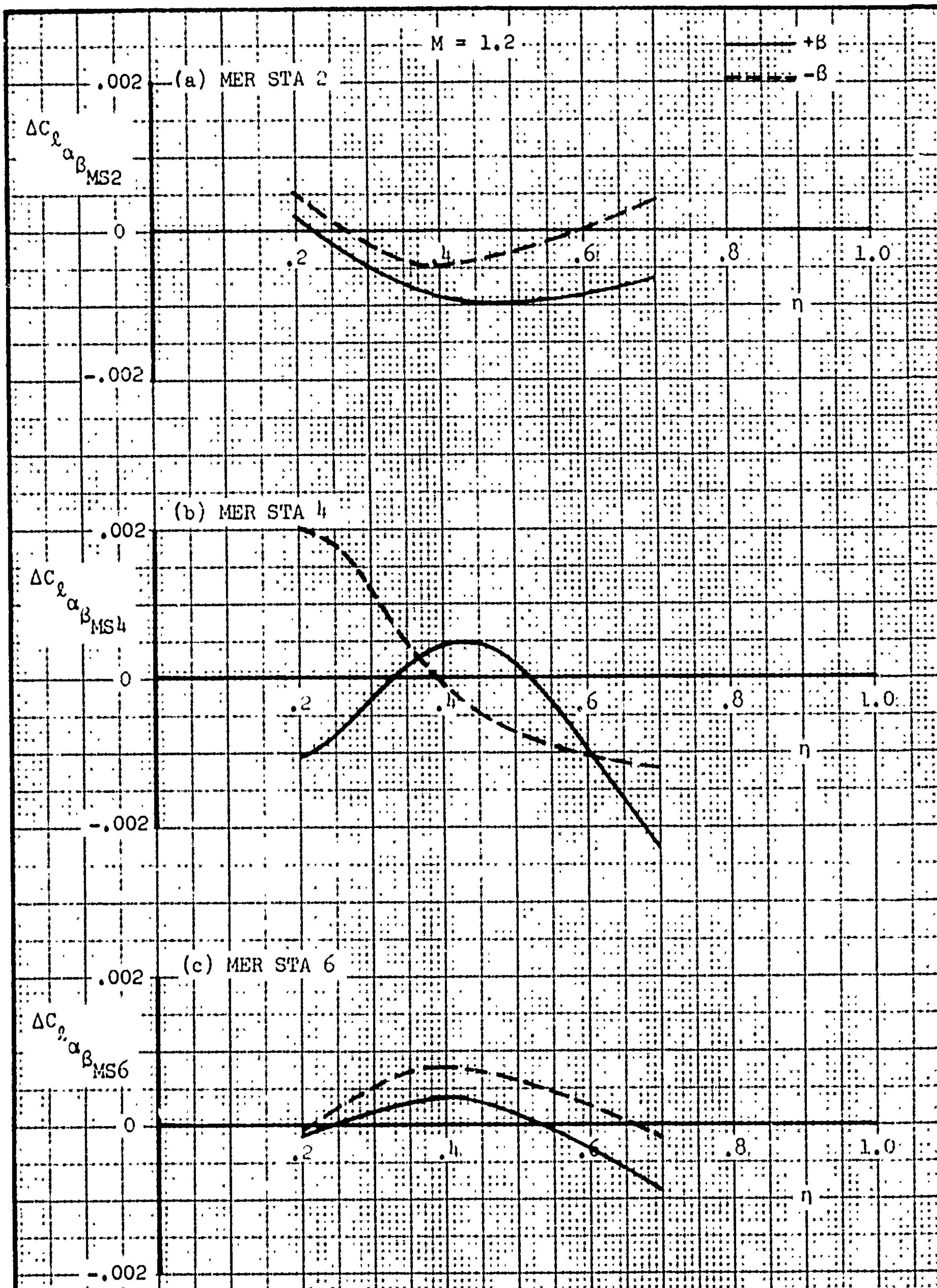


Figure 829. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=1.2 for MER Stations 2,4, and 6

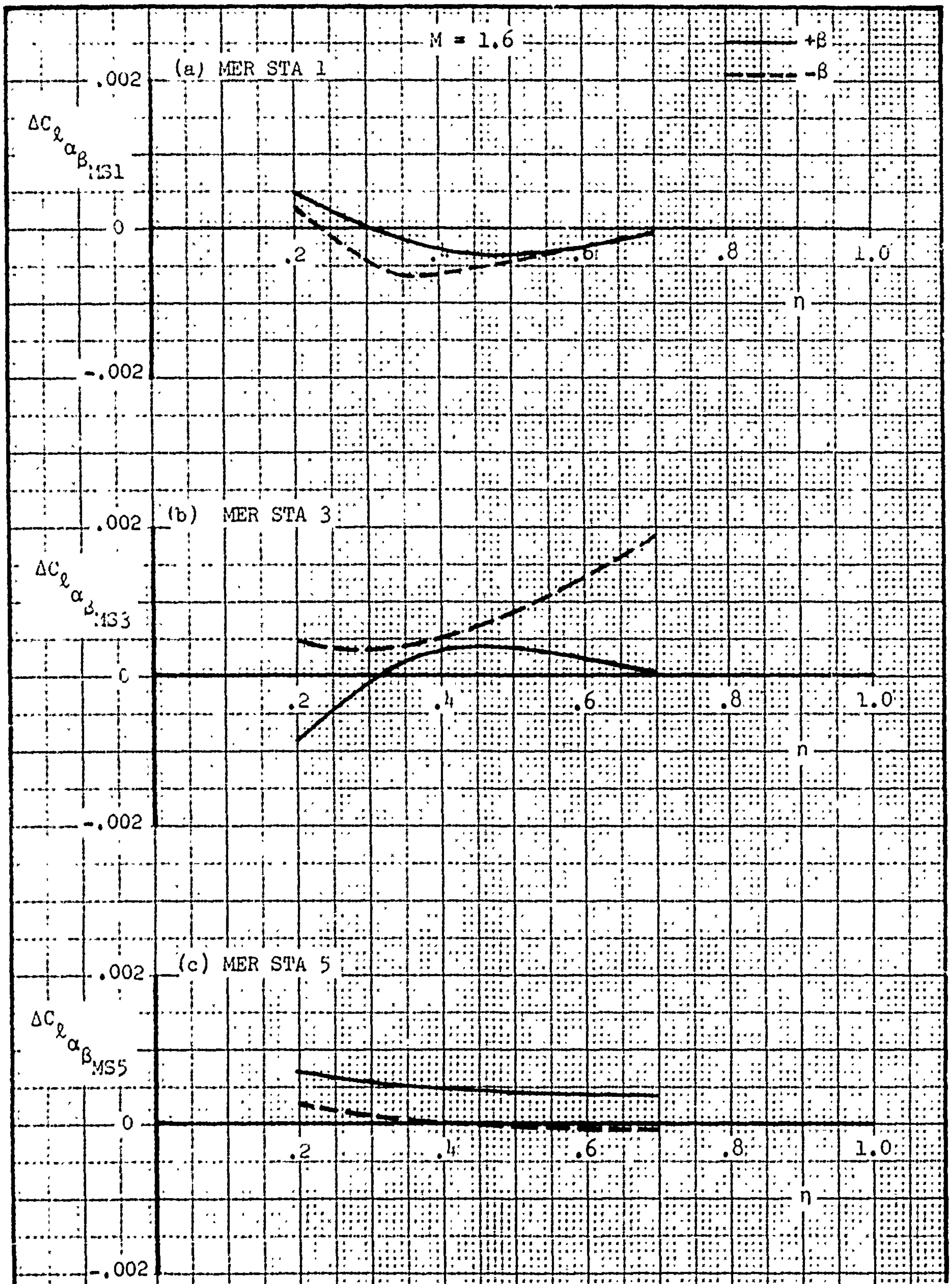


Figure 830. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=1.6 for MER Stations 1,3, and 5

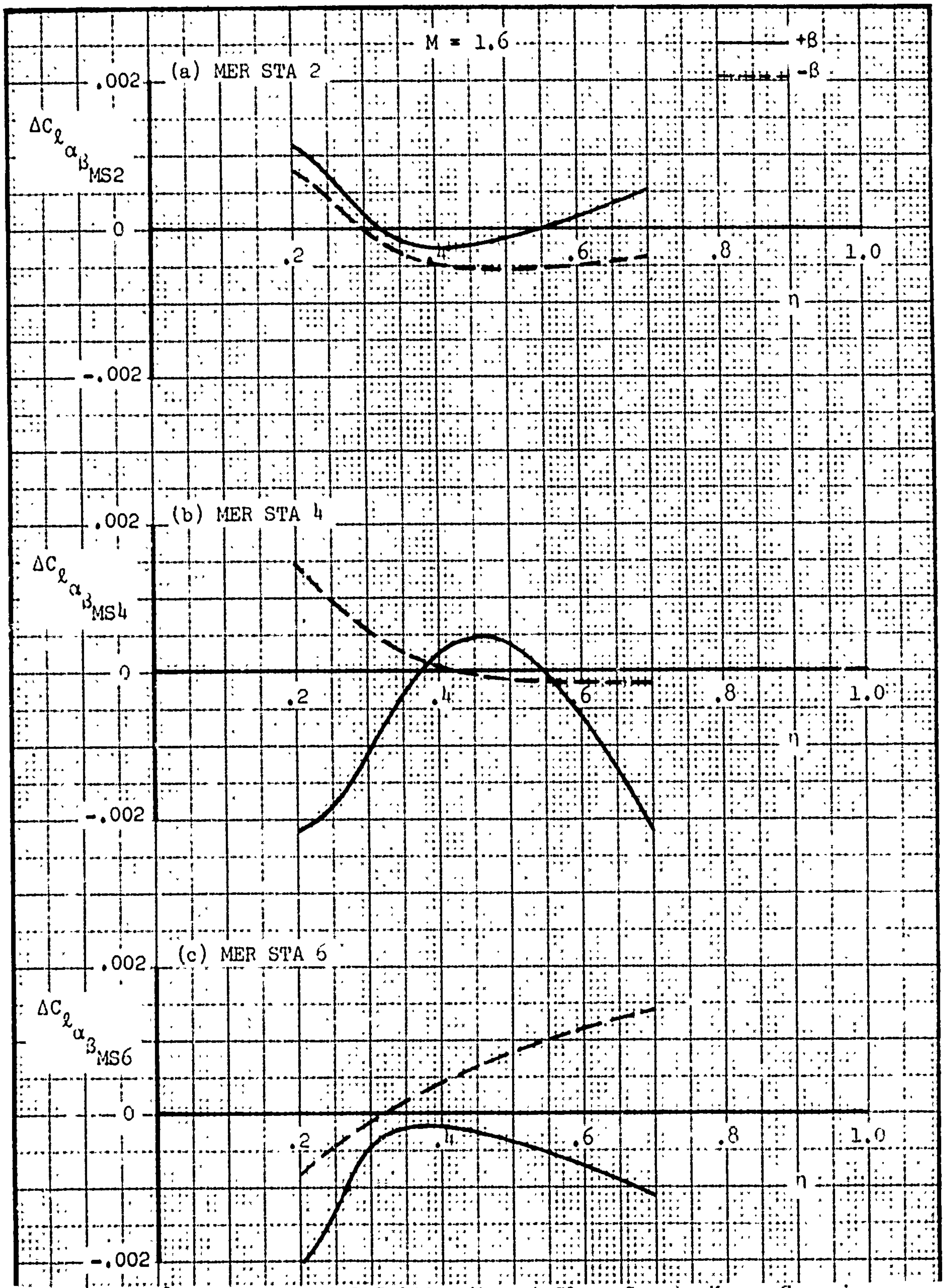


Figure 831. Incremental Rolling Moment Slope Due to Yaw - Spanwise Correction at M=1.6 for MER Stations 2,4, and 6

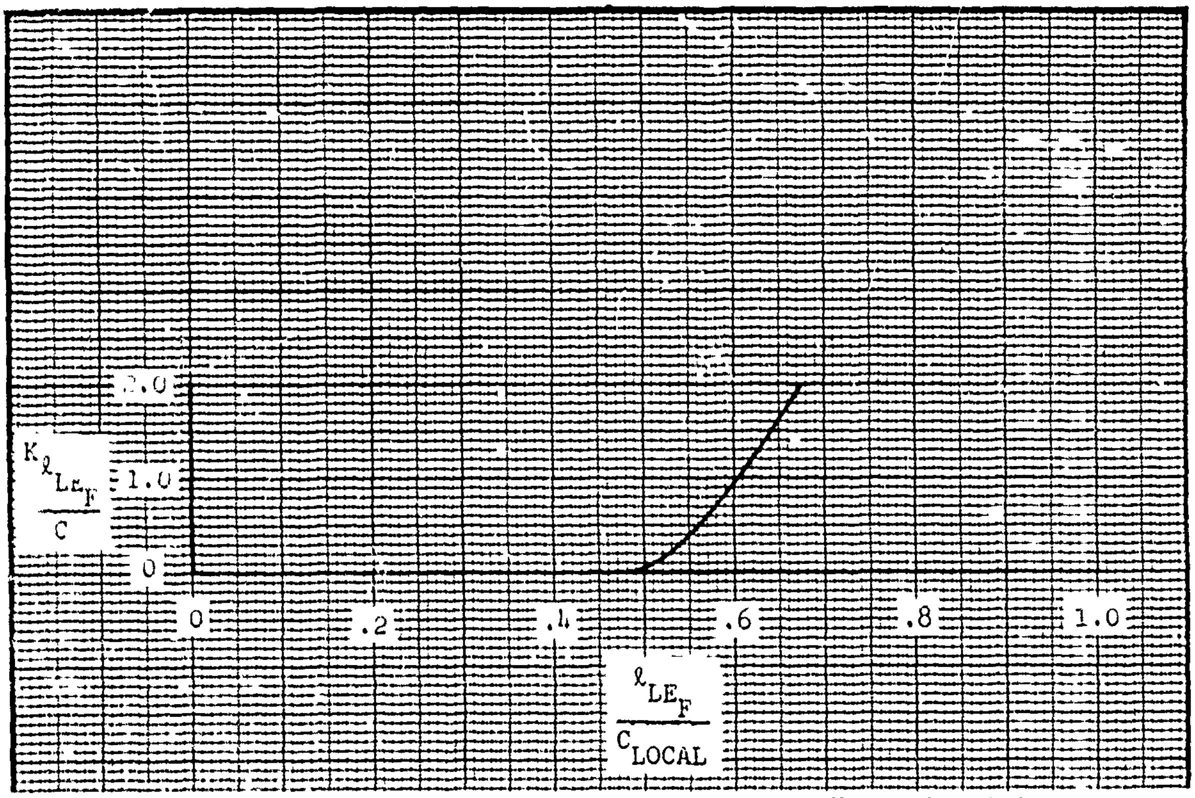


Figure 832. Incremental Rolling Moment Slope Due to Yaw - Chordwise Correction Factor for the Forward Cluster

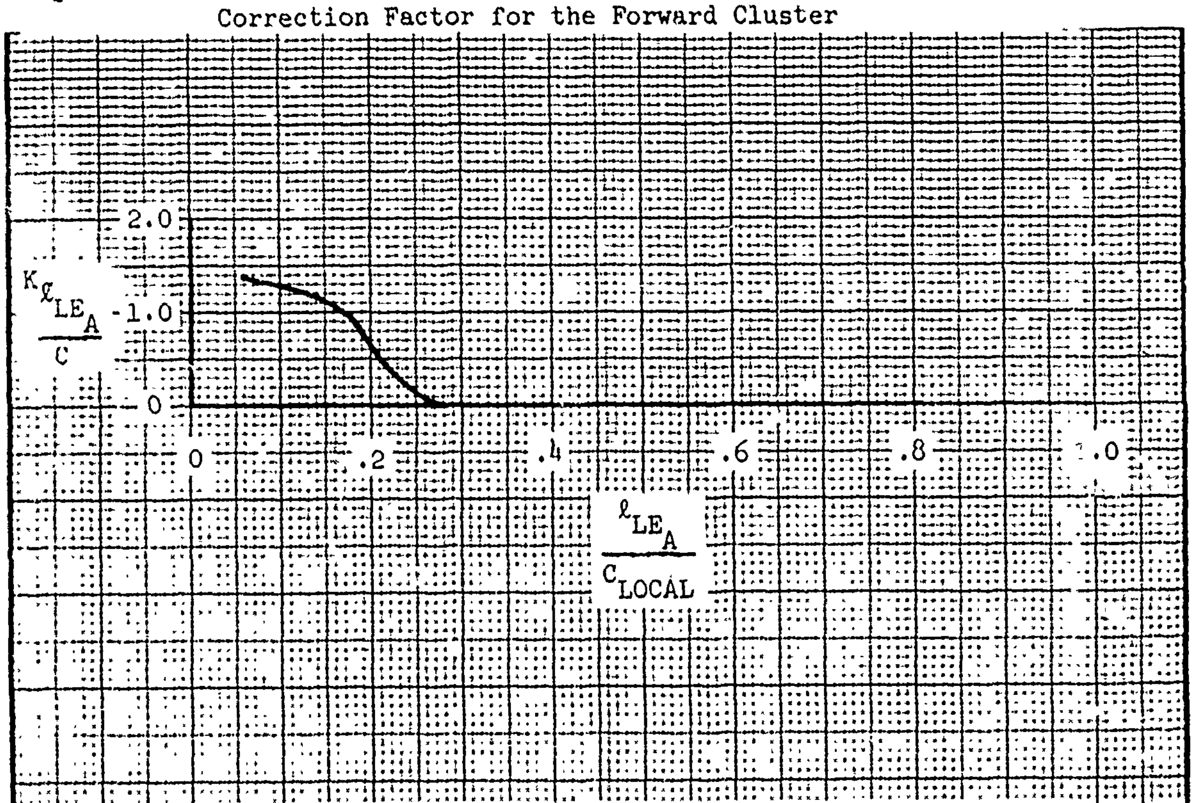


Figure 833. Incremental Rolling Moment Slope Due to Yaw - Chordwise Correction Factor for the Aft Cluster

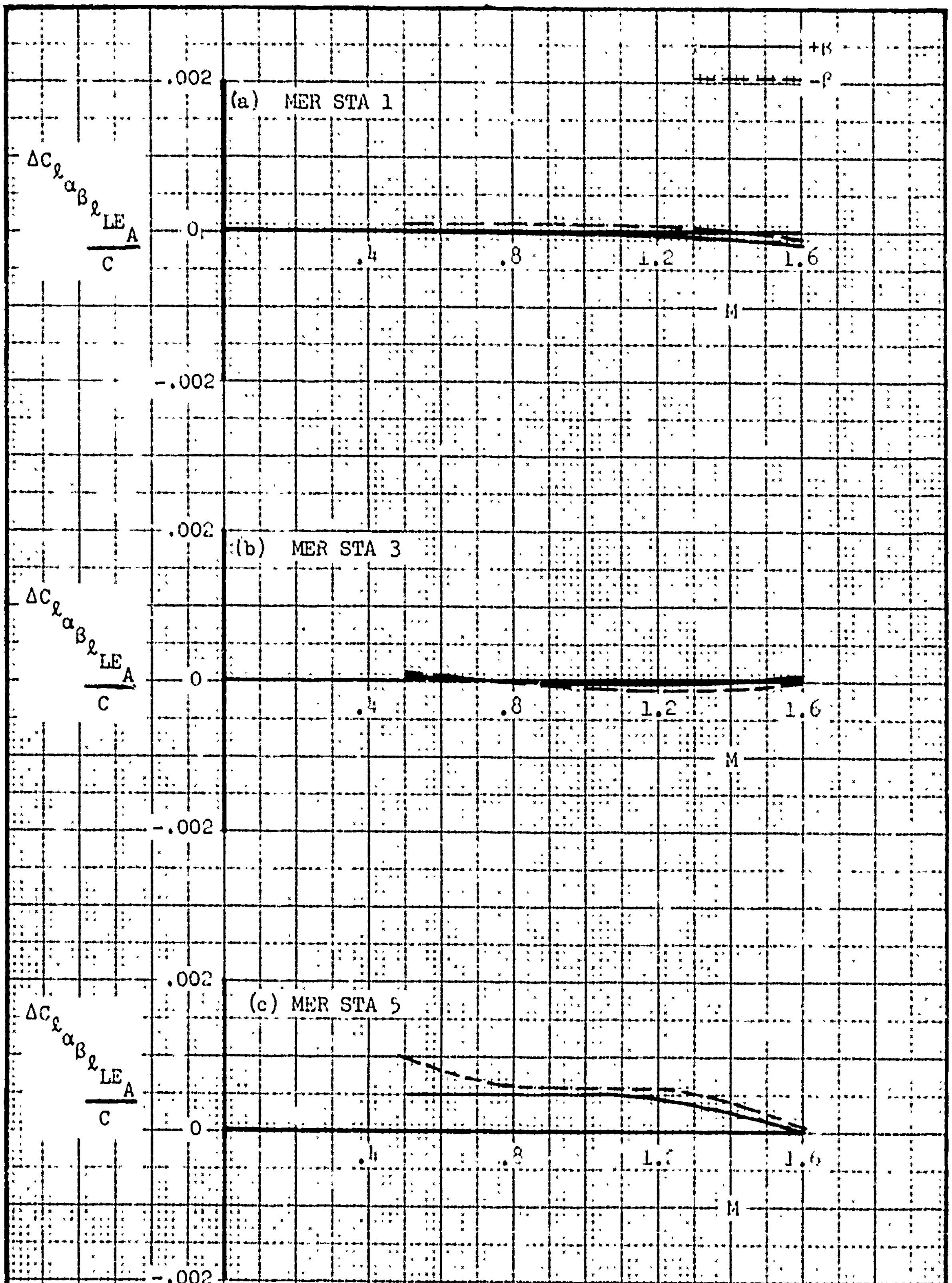


Figure 834. Incremental Rolling Moment Slope Due to Yaw - Chordwise Correction for MER Stations 1,3,and 5

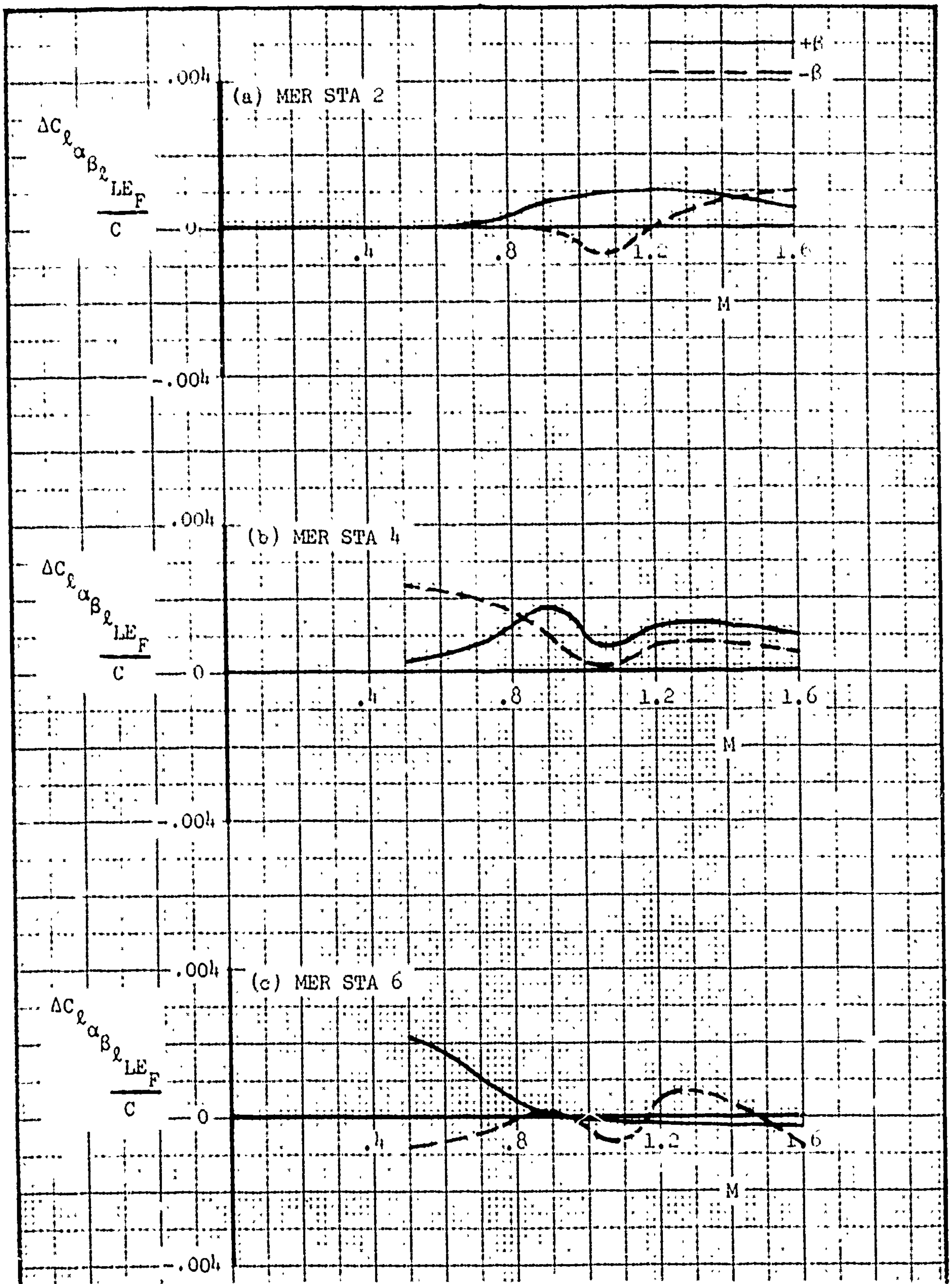


Figure 835. Incremental Rolling Moment Slope Due to Yaw - Chordwise Correction for MER Stations 2,4, and 6

4.6.2.2 Intercept Prediction

The incremental rolling moment intercept prediction is divided into two sections, fuselage centerline-mounted stores and wing-mounted stores. The technique presented in this section covers the Mach number range 0.5 to 1.6.

FUSELAGE CENTERLINE-MOUNTED STORES

MER STATIONS 1-6 (MS1-6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{\beta_{\mathcal{E}}}} = \Delta C_{\ell_{\alpha=0_{\beta_{\mathcal{E}}}}}\ _{MS1-6} \cdot K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\alpha=0_{\beta_{\mathcal{E}}}}}$ - Incremental $C_{\ell_{\alpha=0_\beta}}$ presented as a function of Mach number, $\frac{1}{deg}$.

MER STA 1 - Figure 836
MER STA 2 - Figure 837
MER STA 3 - Figure 836
MER STA 4 - Figure 837
MER STA 5 - Figure 836
MER STA 6 - Figure 837

$K_{SCALE_{RM}}$ - Defined in Subsection 4.6.2, ft^3.

WING-MOUNTED STORES

MER STATIONS 1,3, and 5 (MS1,3,5):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_\beta\ MS1,3,5} = \left(\Delta C_{\ell_{\alpha=0_\beta}}\ _{MS1,3,5} + K_{\ell_{\frac{LE_A}{C}}} \Delta C_{\ell_{\alpha=0_{\beta_{\ell_{\frac{LE}{C}}}}}}\right) K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\alpha=0_\beta}}$ - Incremental $C_{\ell_{\alpha=0}}$ per degree β presented as a function of wing spanwise position for Mach numbers 0.7, 0.9, 1.05, 1.2, and 1.6, $\frac{1}{deg}$, Table 24.

$K_{\frac{\ell_{LE_A}}{C}}$ - Proportioning factor based on the distance from the wing leading edge to the nose of the store or MER Station 1 measured in the wing plan view divided by the local wing chord, positive, Figure 849.

$\Delta C_{\ell_{\alpha=0_{\beta_{\frac{\ell_{LE_A}}{C}}}}}$ - Incremental $C_{\ell_{\alpha=0}}$ per degree β based on ℓ_{LE_A}/C defined above and presented as a function of Mach number, $\frac{1}{deg}$.

MER STA 1 - Figure 851
MER STA 3 - Figure 851
MER STA 5 - Figure 851

$K_{SCALE_{RM}}$ - Defined in Subsection 4.6.2, ft^3.

MER STATIONS 2,4, and 6 (MS2,4,6):

$$\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{\beta_{MS2,4,6}}} = \left(\Delta C_{\ell_{\alpha=0_{\beta_{MS2,4,6}}}} + K_{\frac{\ell_{LE_F}}{C}} \cdot \Delta C_{\ell_{\alpha=0_{\beta_{\frac{\ell_{LE_F}}{C}}}}}\right) K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\alpha=0_\beta}}$ - Incremental $C_{\ell_{\alpha=0}}$ per degree β presented as a function of wing spanwise position for Mach numbers 0.7, 0.9, 1.05, 1.2, and 1.6, $\frac{1}{deg}$, Table 24.

$K_{\frac{\ell_{LE_F}}{C}}$ - Porportioning factor based on the distance from the wing leading edge to the nose of the store on MER Station 2 measured in the wing plan view divided by the local wing chord, positive, Figure 848.

$\Delta C_{\ell_{\alpha=0}}{}_{\beta_{\frac{\ell_{LE_F}}{C}}}$ - Incremental $C_{\ell_{\alpha=0}}$ per degree β based on ℓ_{LE_F}/C defined above and presented as a function of Mach number, $\frac{1}{deg}$,

MER STA 2 - Figure 850

MER STA 4 - Figure 850

MER STA 6 - Figure 850

$K_{SCALE_{RM}}$ - Defined in Subsection 4.6.2, ft^3.

The variation of $C_{\ell_{\alpha=0}}$ for MER Stations 1-6 is presented at distinct Mach numbers of 0.7, 0.9, 1.05, 1.2, and 1.6. Table 24 presented below is a guide for locating the curves for $\Delta C_{\ell_{\alpha=0_\beta}}$ for each MER Station at the Mach numbers indicated above. For Mach numbers between 0.5 and 0.7, the value at M = 0.7 should be used in the computation. For Mach numbers between 0.7 and 1.6 other than those distinctly presented, linear interpolation should be used between the appropriate Mach numbers to obtain the required value for computation

TABLE 24. INCREMENTAL ROLLING MOMENT INTERCEPT COEFFICIENT DUE TO YAW - FIGURE LOCATION GUIDE

$\Delta C_{\ell_{\alpha=0_{\beta}}}$	MACH NUMBERS 0.7	0.9	1.05	1.2	1.6
	Figure Numbers				
MER STA 1	838	840	842	844	846
MER STA 2	839	841	843	845	847
MER STA 3	838	840	842	844	846
MER STA 4	839	841	843	845	847
MER STA 5	838	840	842	844	846
MER STA 6	839	841	843	845	847

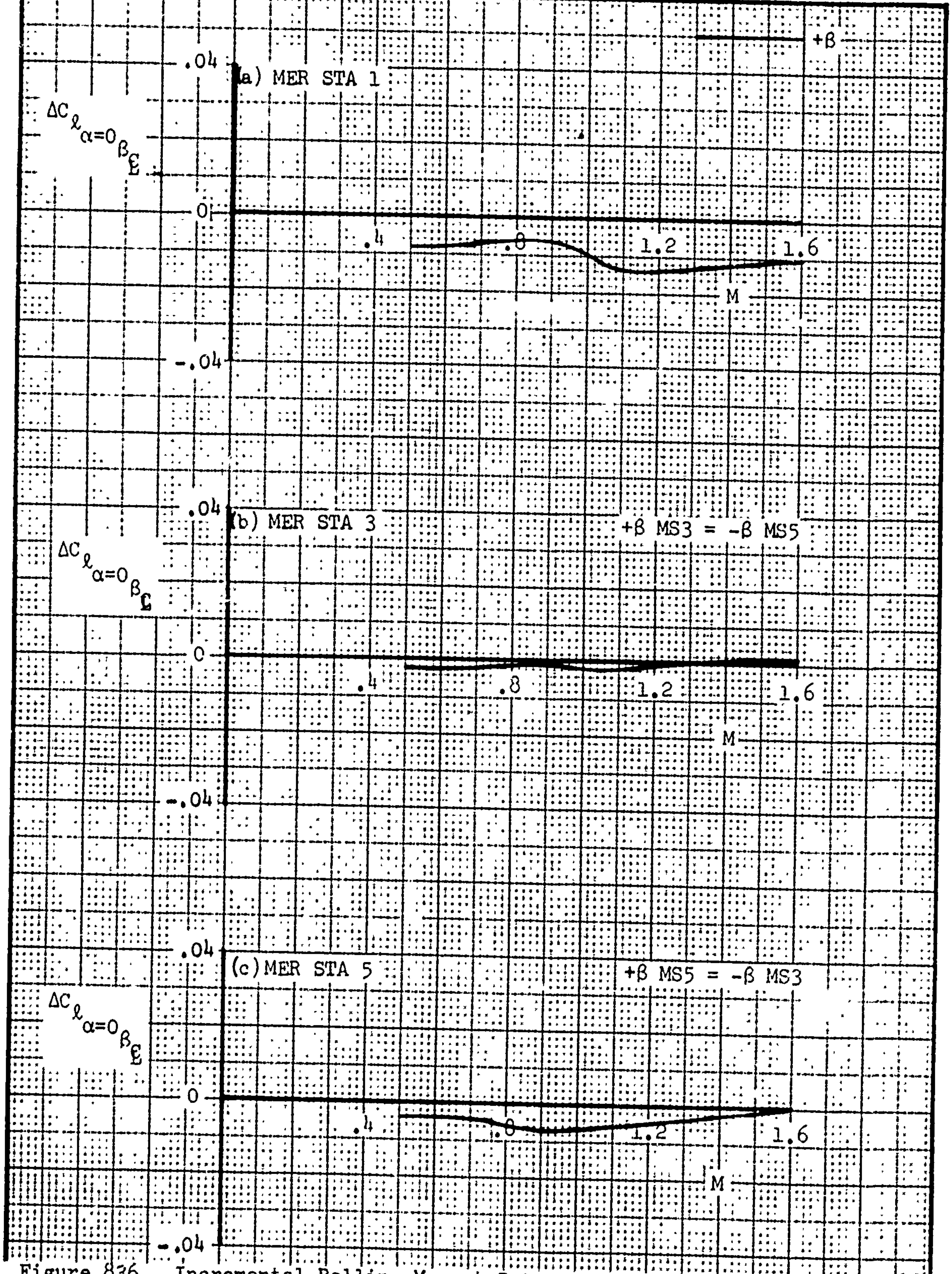


Figure 836. Incremental Rolling Moment Intercept Due to Yaw - Coefficient for Stores Mounted on Fuselage Centerline, MER Stations 1,3,and 5

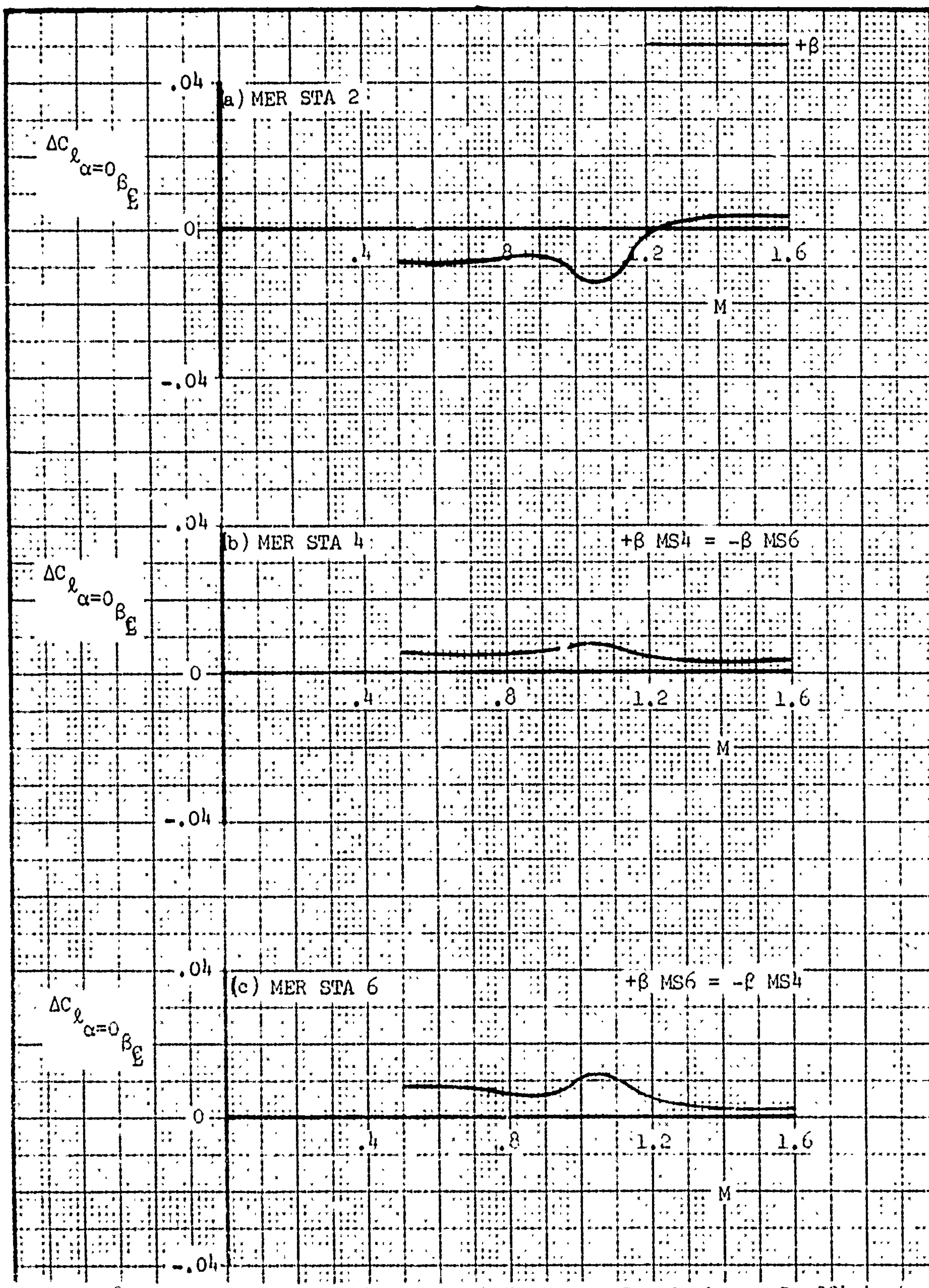


Figure 827. Incremental Rolling Moment Intercept Due to Yaw - Coefficient for Stores Mounted on Fuselage Centerline, MER Stations 2,4,and 6

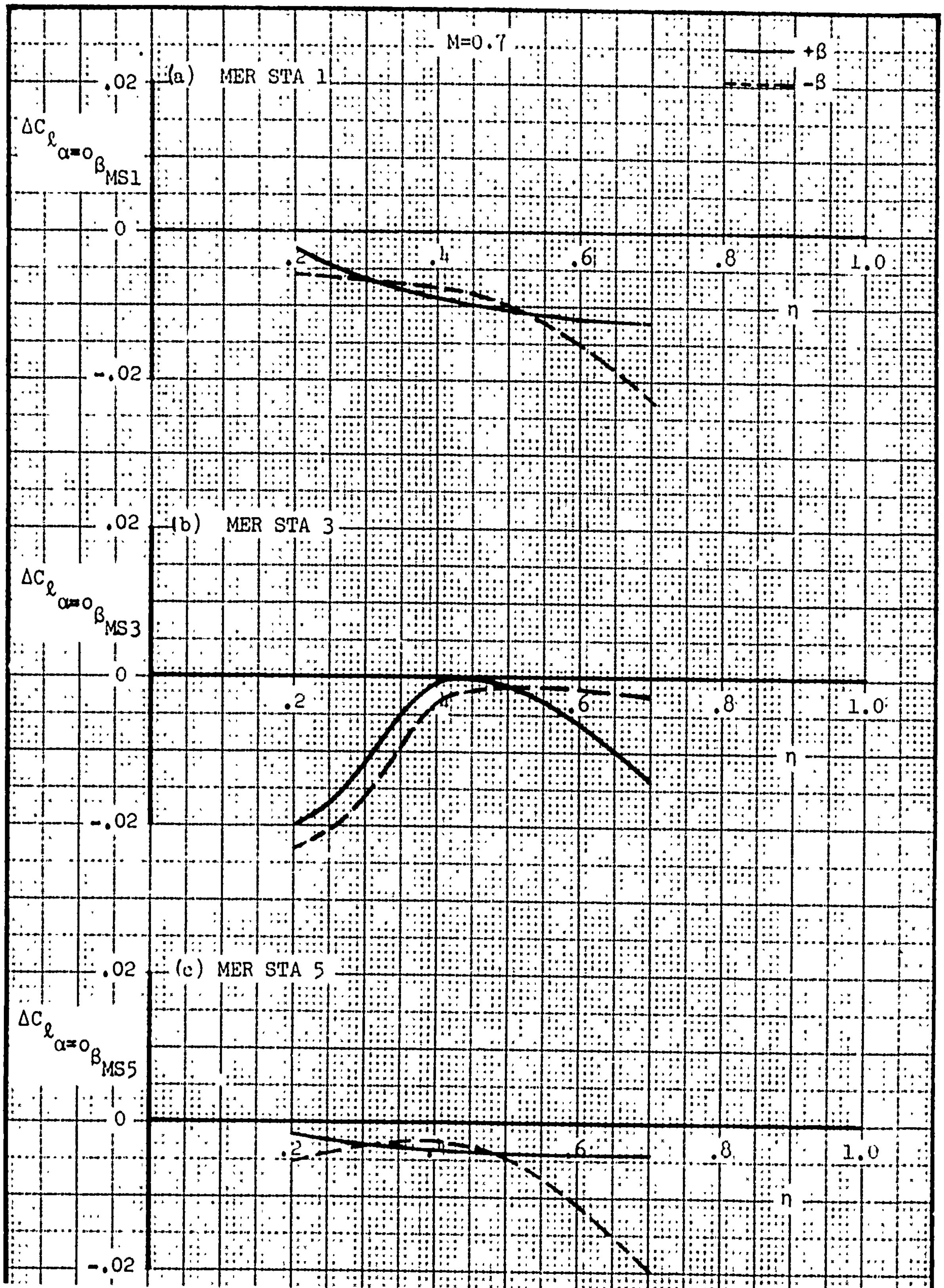


Figure 838. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=0.7 for MER Stations 1,3 , and 5

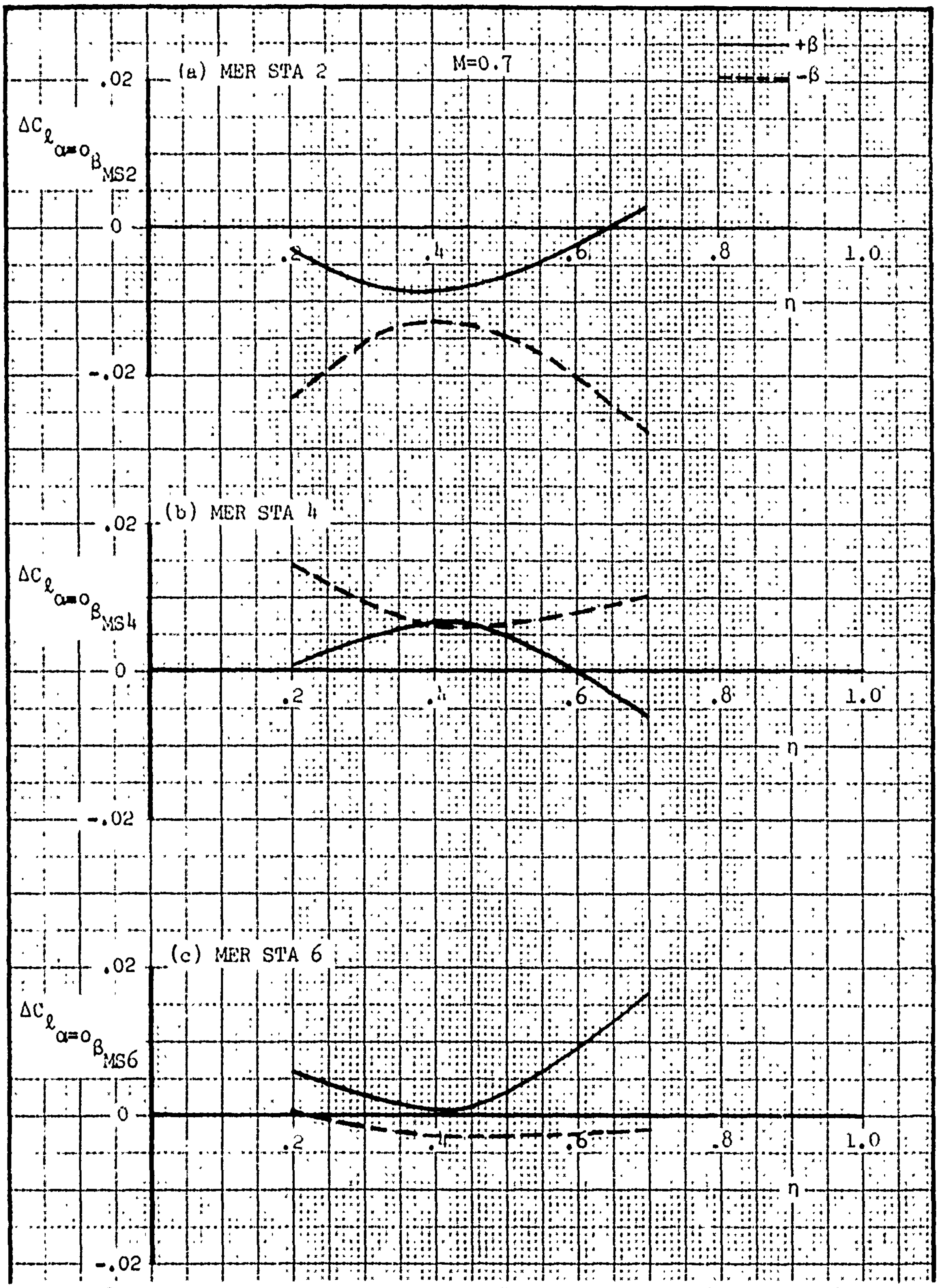


Figure 839. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=0.7 for MER Stations 2,4, and 6

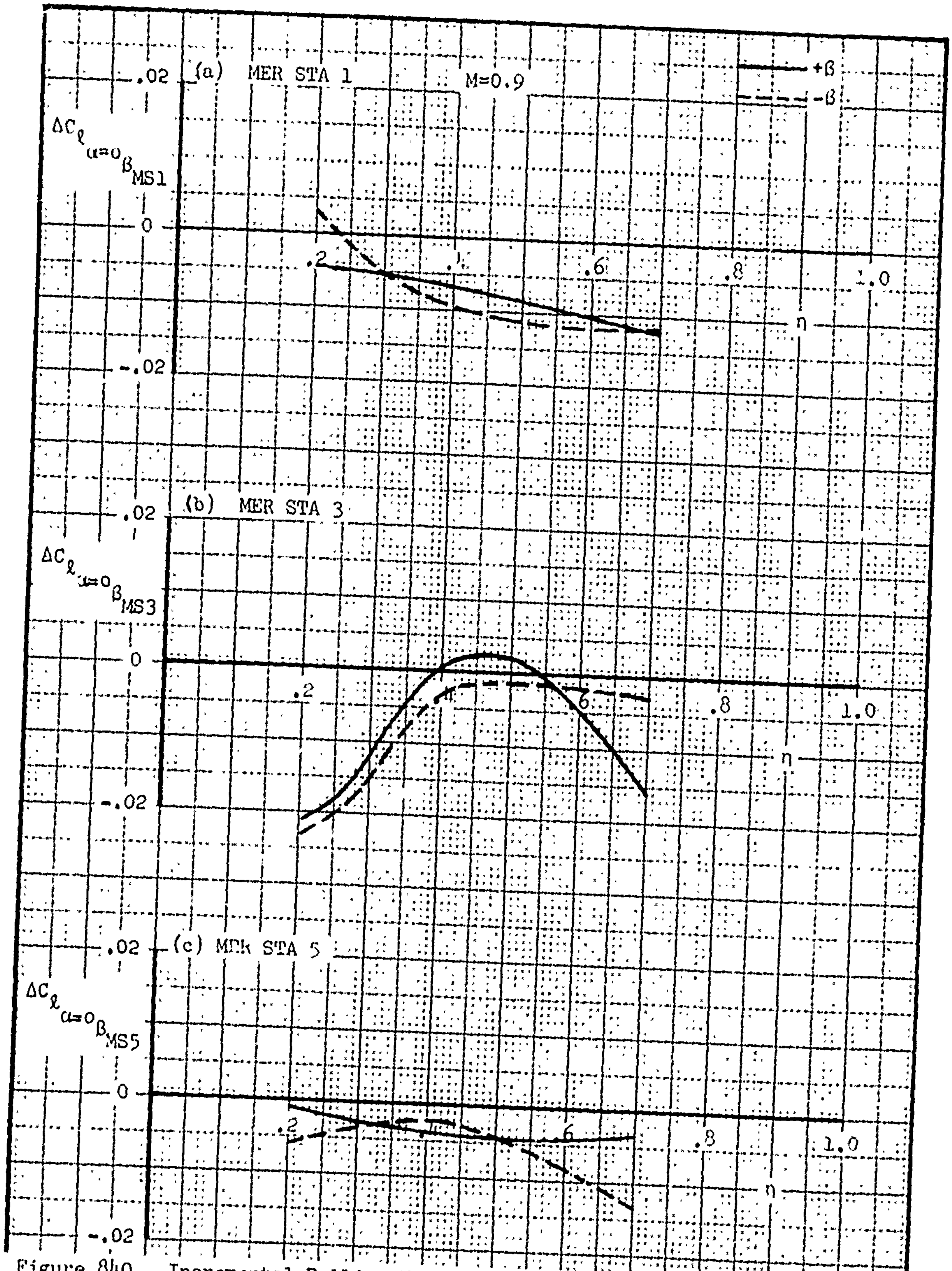


Figure 840. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=0.9 for MER Stations 1,3, and 5

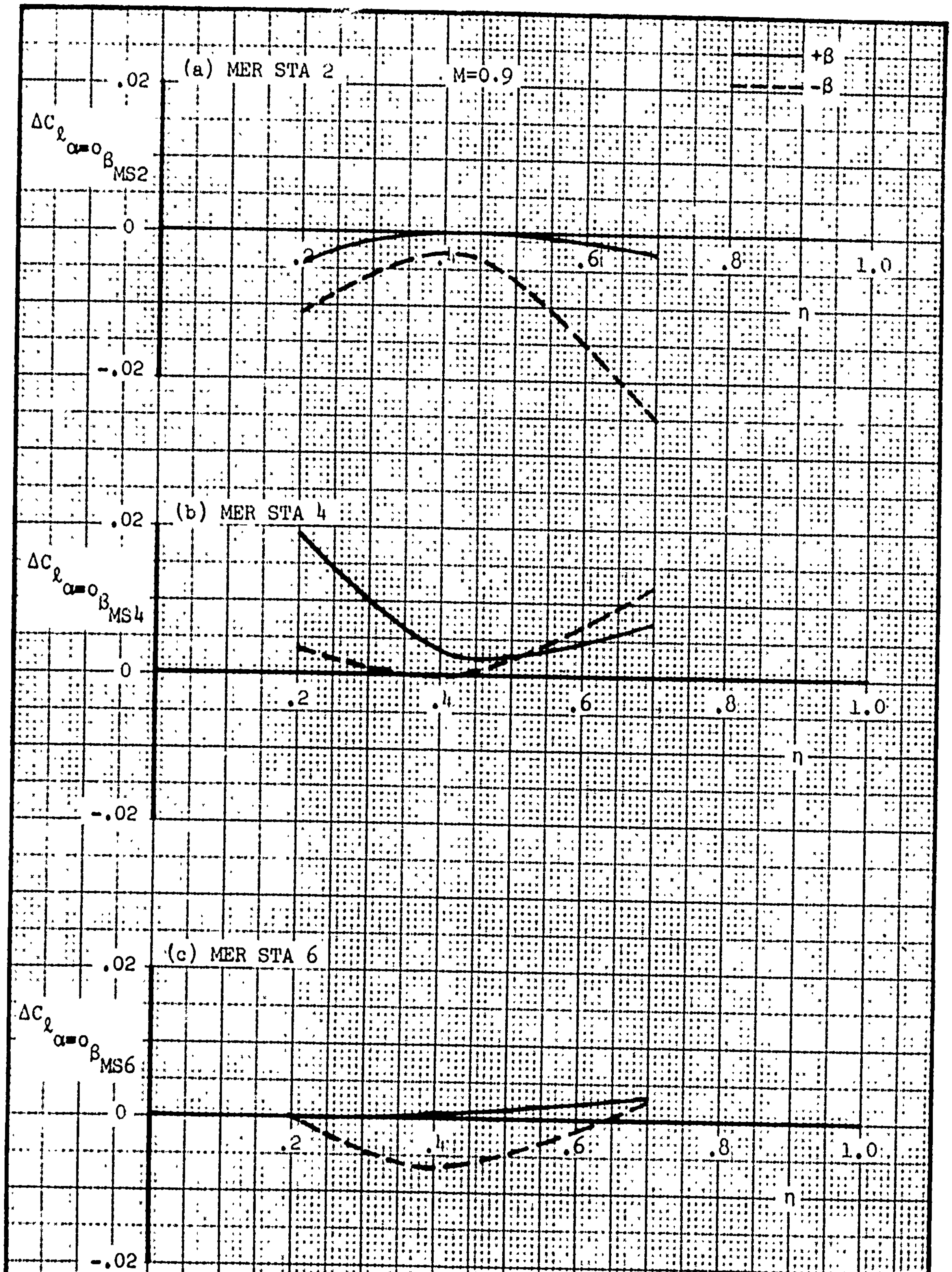


Figure 841. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=0.9 for MER Stations 2,4, and 6

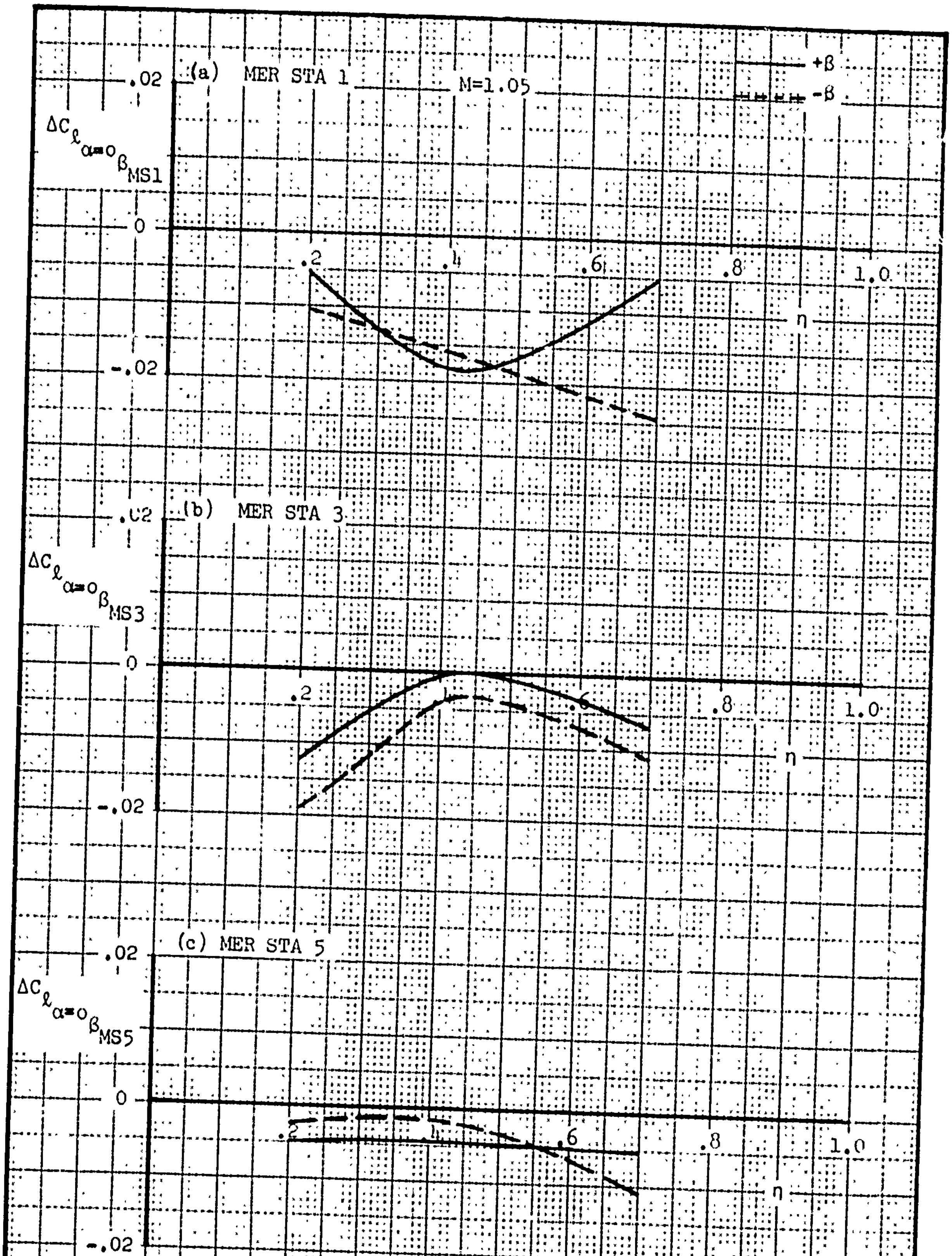


Figure 842. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=1.05 for MER Stations 1,3,and 5

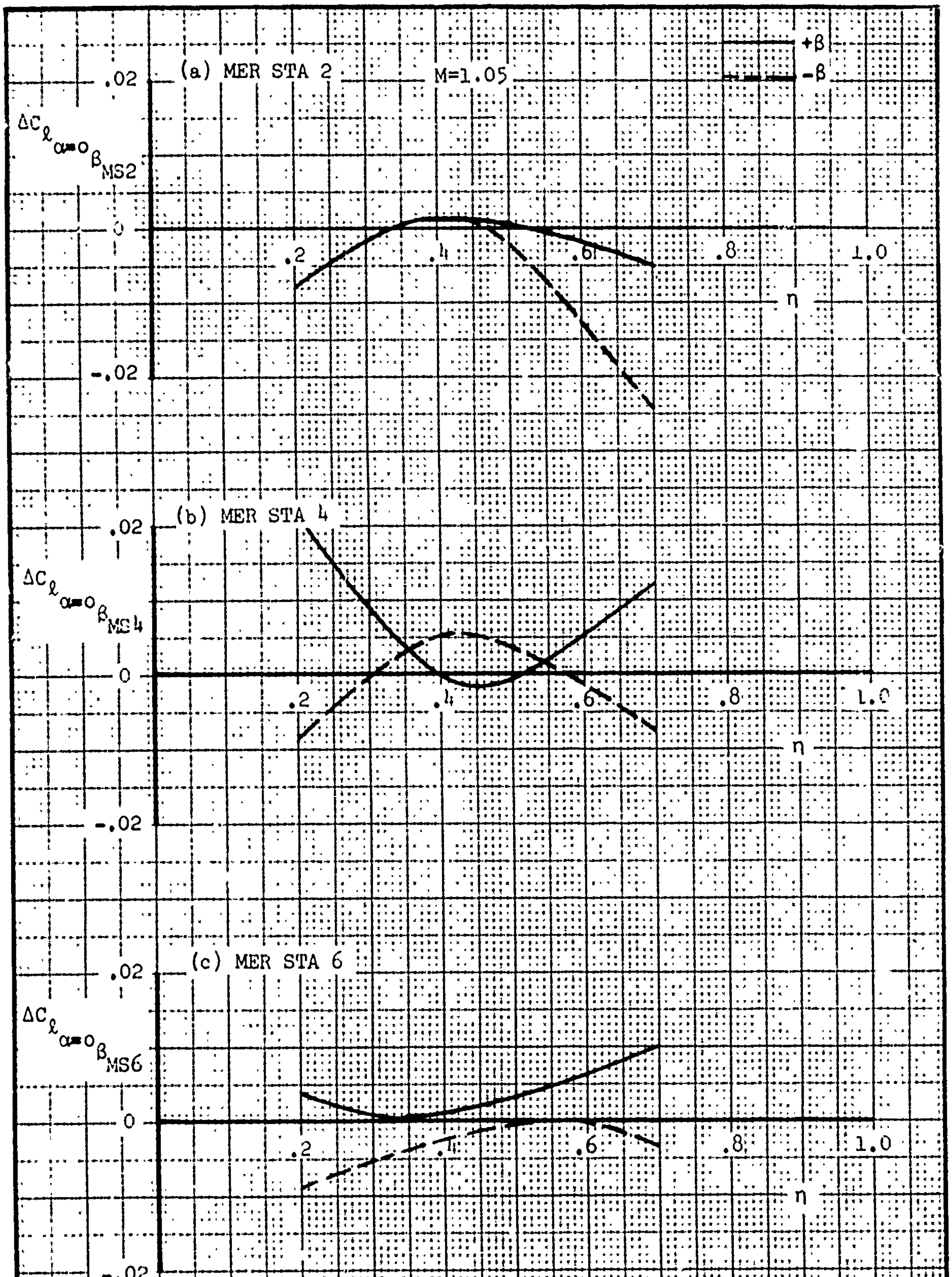


Figure 843. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=1.05 for MER Stations 2,4,and 6

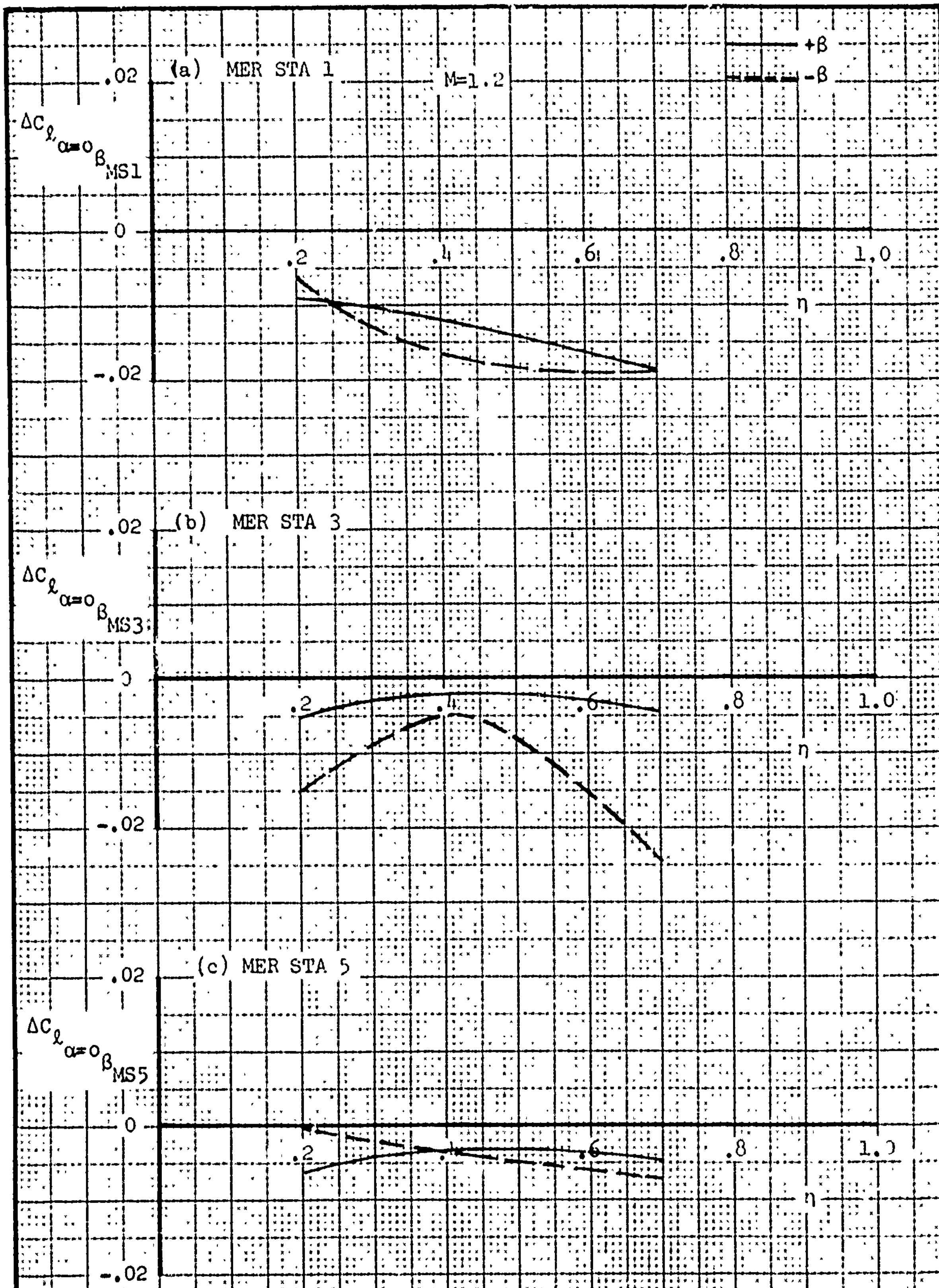


Figure 844. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=1.2 for MER Stations 1,3, and 5

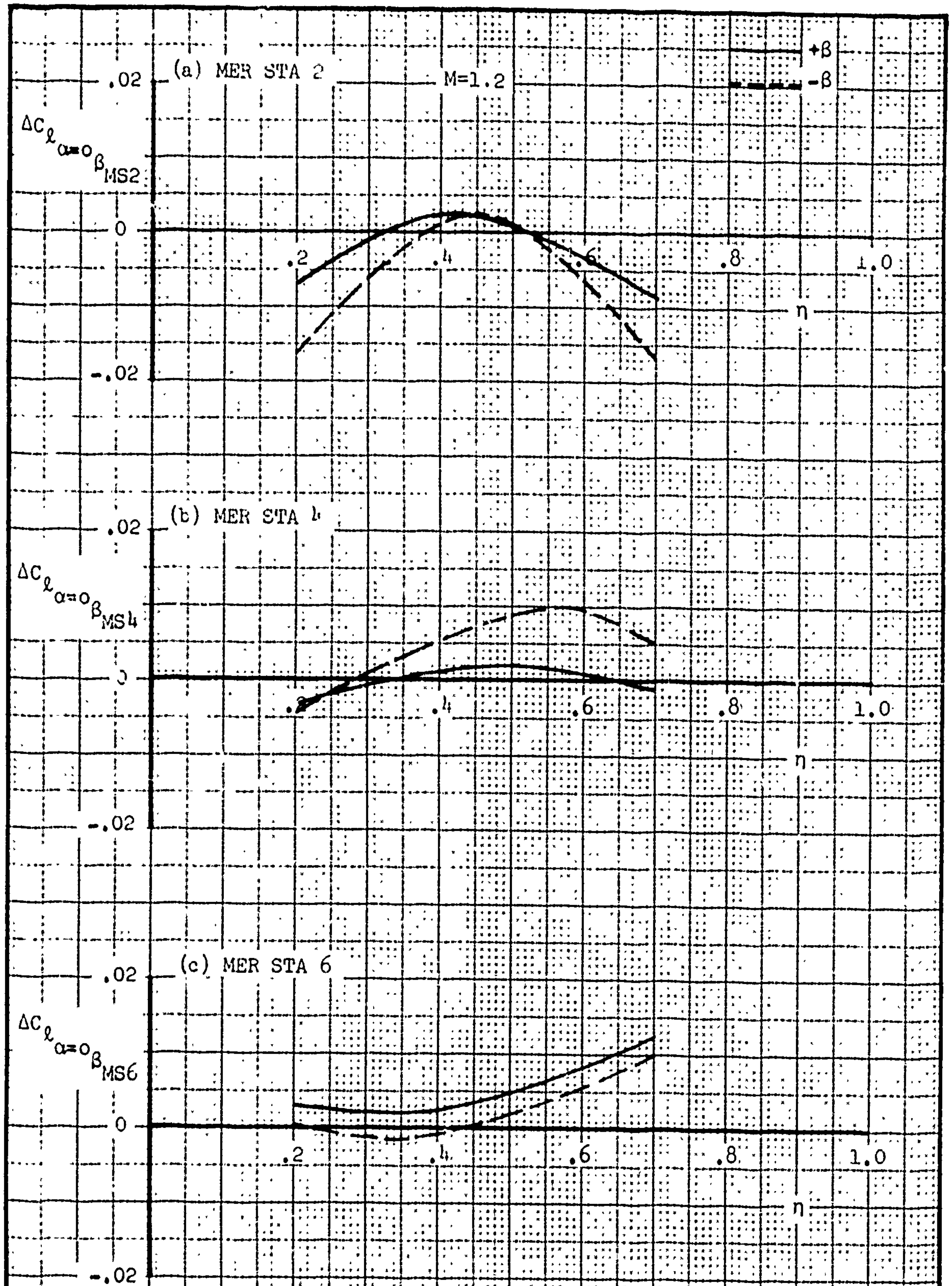


Figure 845. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=1.2 for MER Stations 2,4, and 6

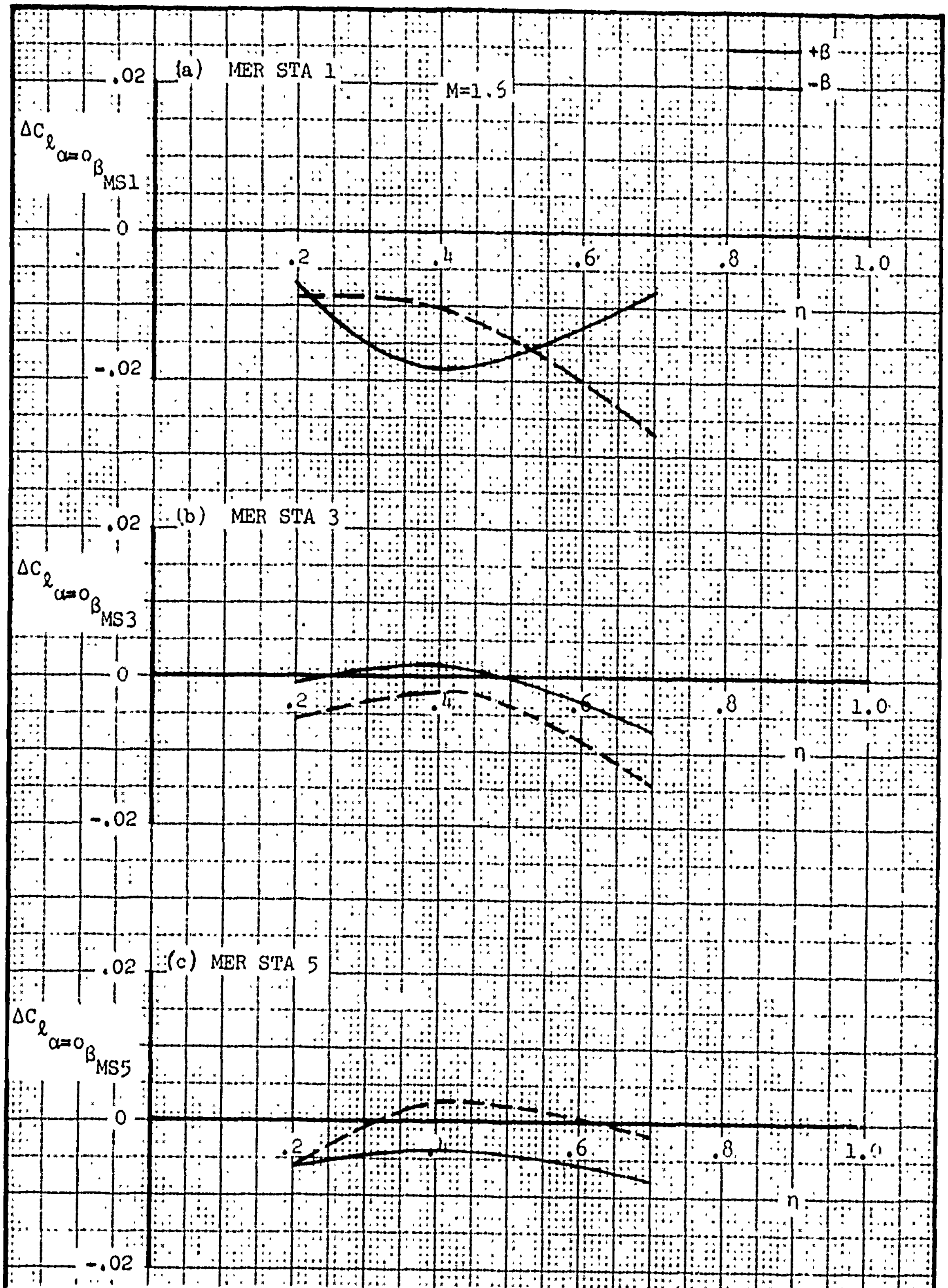


Figure 846. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=1.6 for MER Stations 1,3, and 5

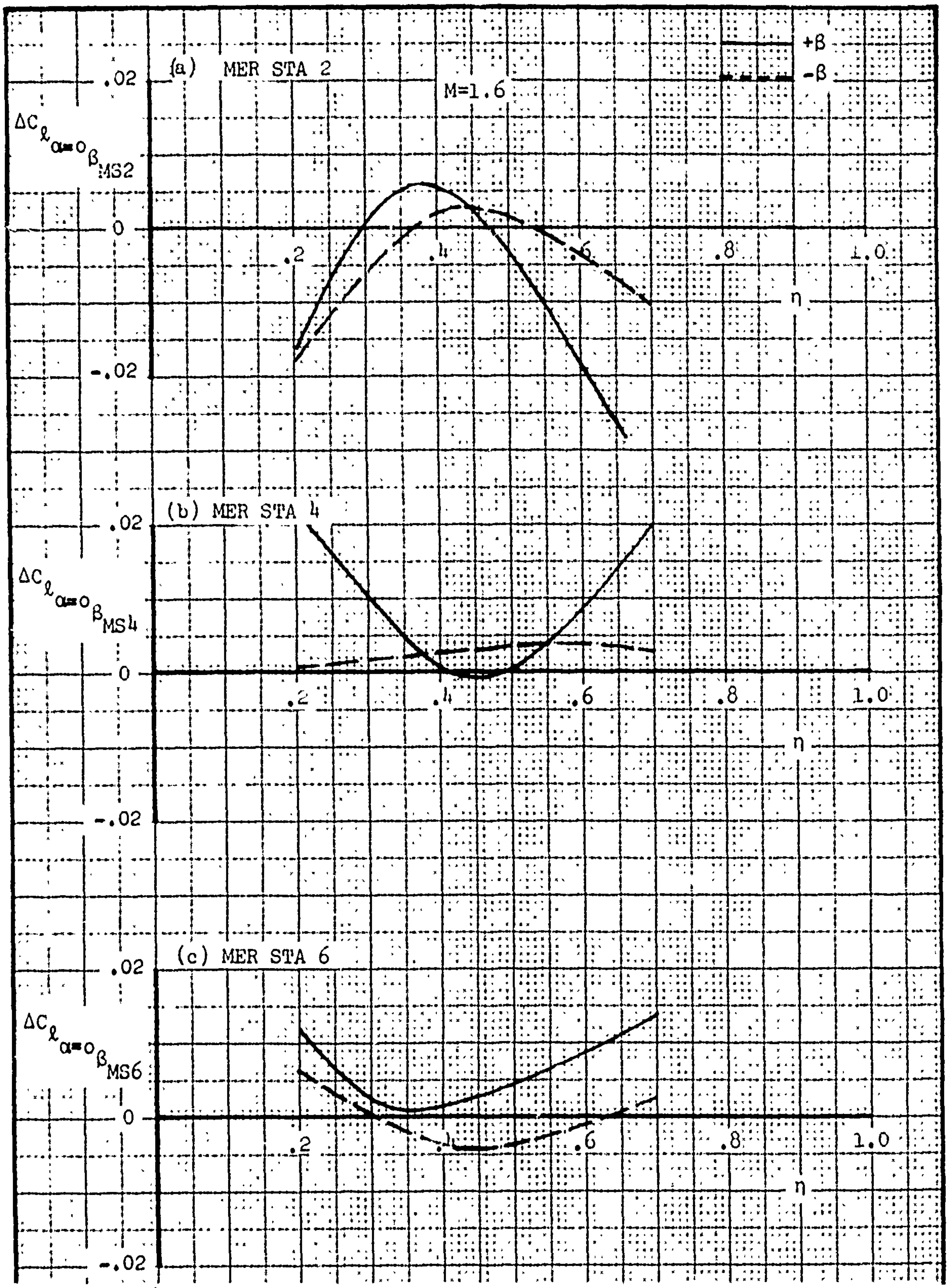


Figure 847. Incremental Rolling Moment Intercept Due to Yaw - Spanwise Correction at M=1.6 for MER Stations 2,4, and 6

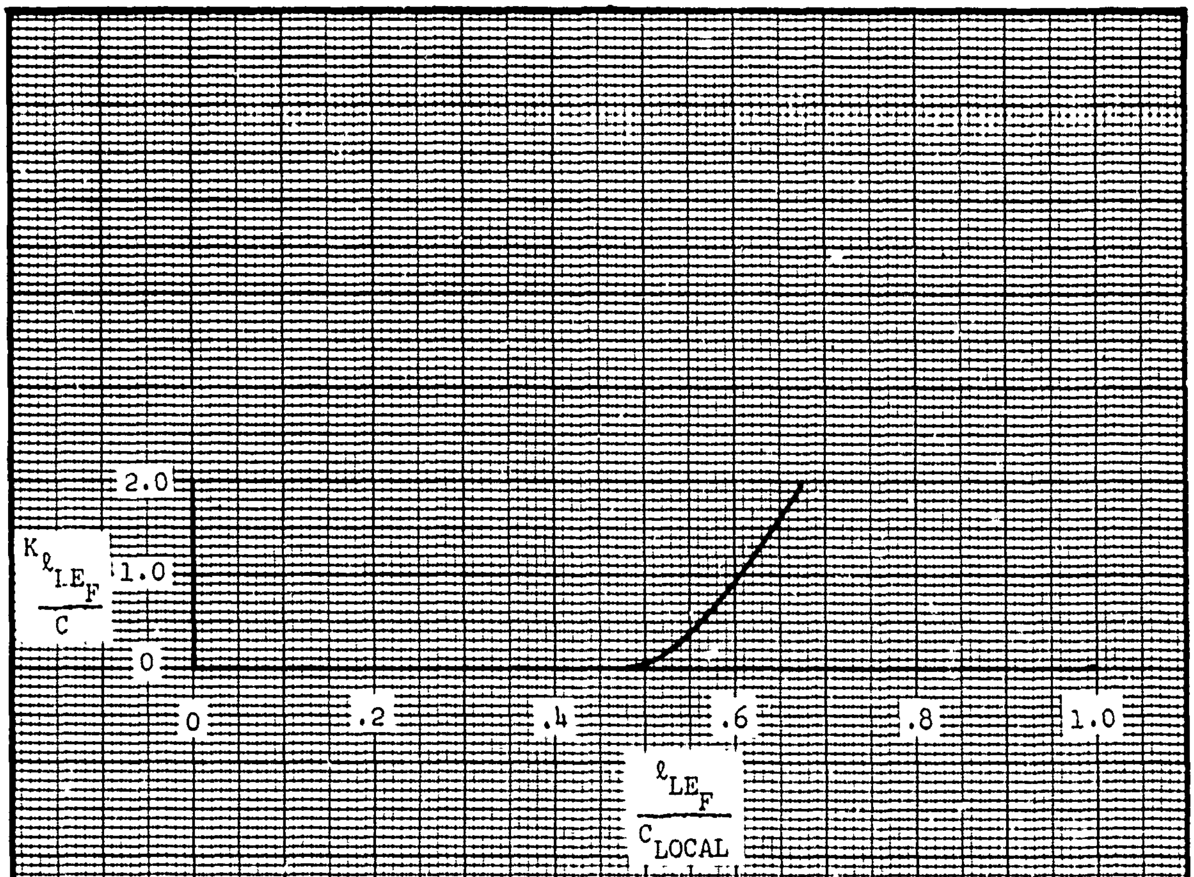


Figure 848. Incremental Rolling Moment Intercept Due to Yaw - Chordwise Correction Factor for the Forward Cluster

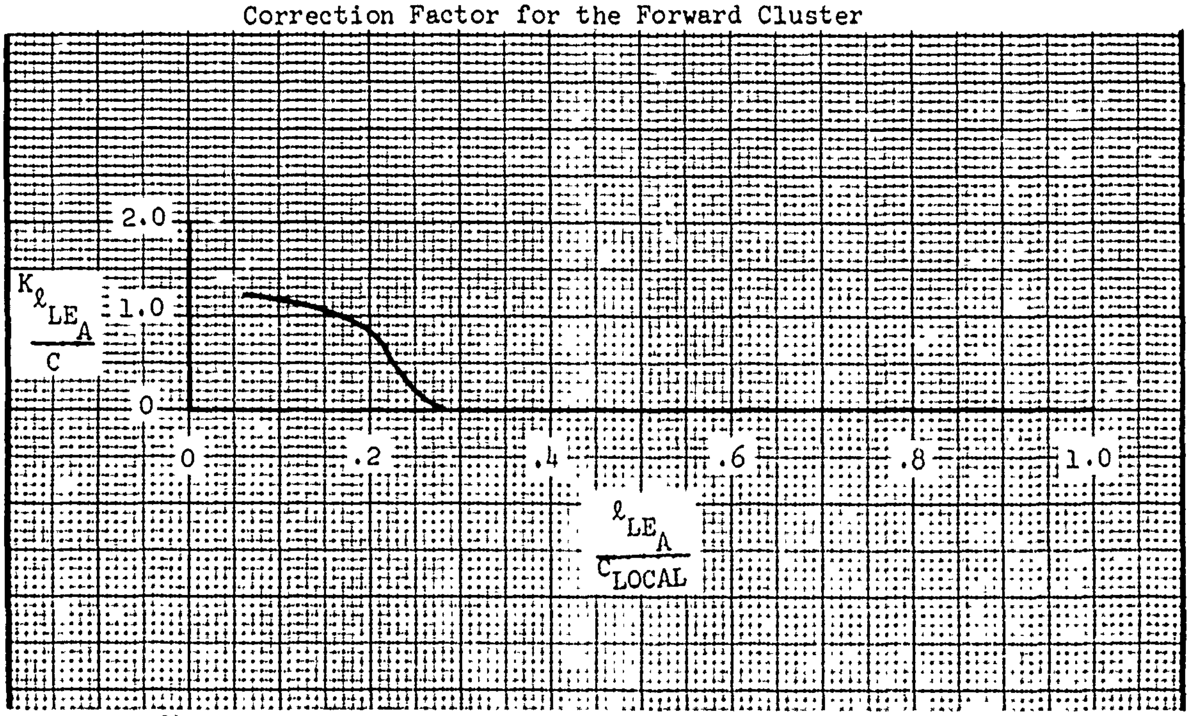


Figure 849. Incremental Rolling Moment Intercept Due to Yaw - Chordwise Correction Factor for the Aft Cluster

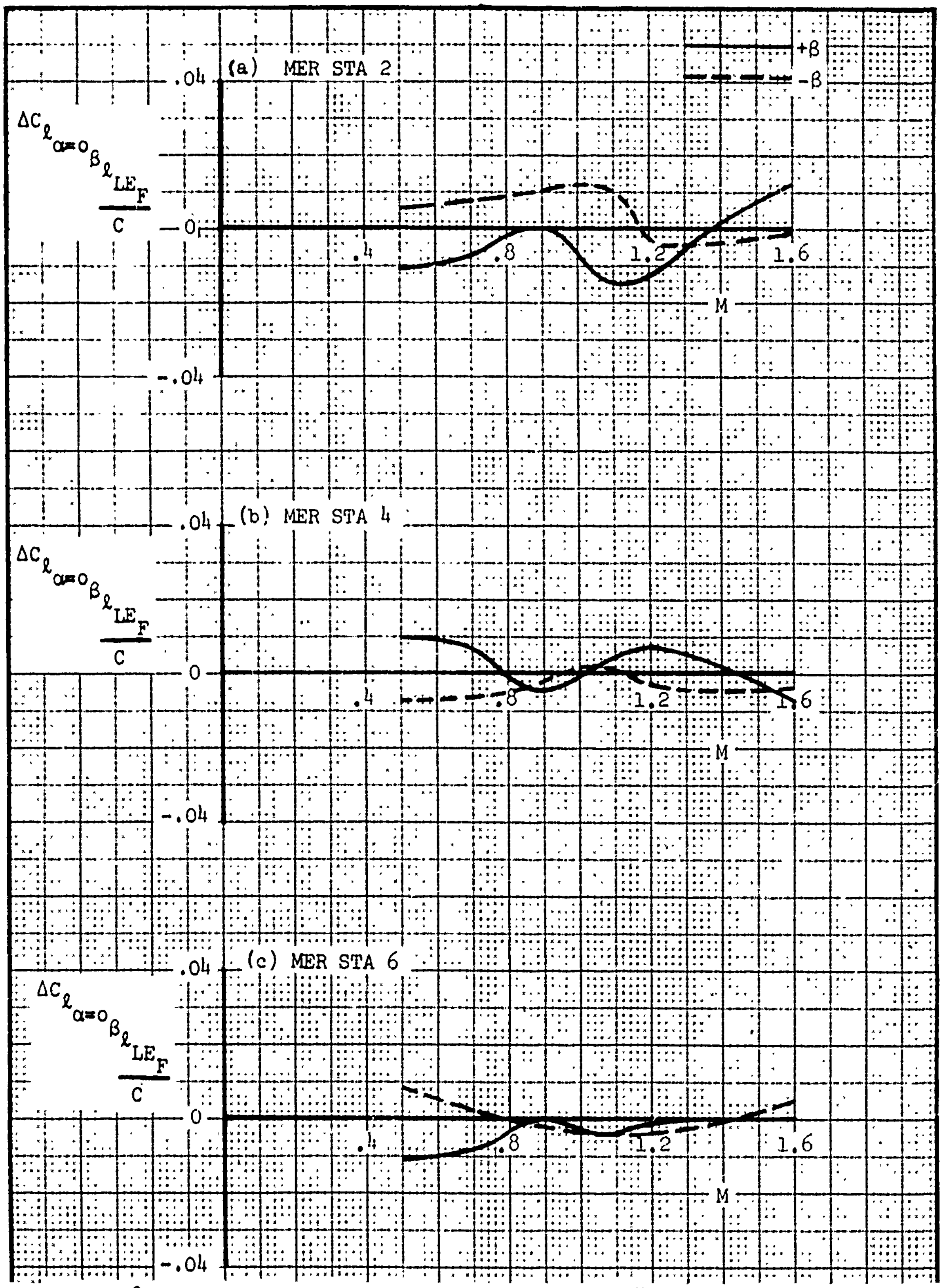


Figure 850. Incremental Moment Intercept Due to Yaw - Chordwise Correction for MER Stations 2,4 and 6

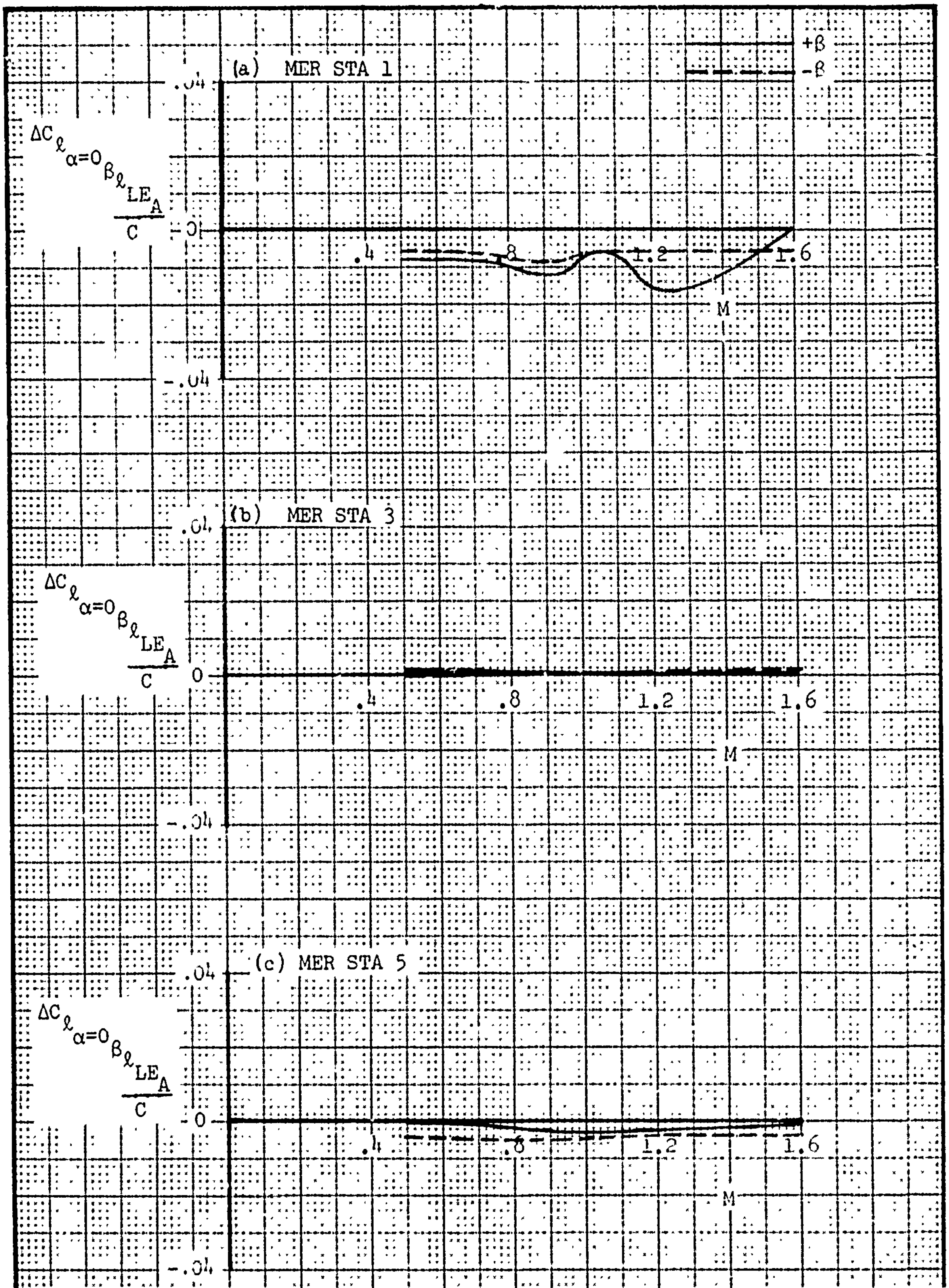


Figure 851. Incremental Rolling Moment Intercept Due to Yaw - Chordwise Correction for MER Stations 1,3, and 5

4.6.3 Increment-Adjacent Store Interference

Methods to predict the increment in captive store rolling moment variation with angle of attack, $\Delta\left(\frac{RM}{q}\right)_{\alpha_{INTF}}$, and the value at $\alpha=0$, $\Delta\left(\frac{RM}{q}\right)_{\alpha=0_{INTF}}$, for multiple carried stores are presented within this section. The basic prediction is made as a function of minimum store to store separation distance, y_{INTF} (see Subsection 3.1.3), at discrete Mach numbers. The data are presented separately for the aft cluster of stores on MER, Stations 1, 3 and 5 and the forward cluster, MER Stations 2, 4 and 6. Predictions are also separately made for inboard → outboard interference, the interfering store carried inboard of the subject captive store, and outboard → inboard interference, the interfering store carried outboard of the subject captive store. On the curves defining the basic prediction ADJ. SHOULDER refers to the MER shoulder store adjacent to the interfering store, OPPOSITE SHOULDER is the MER shoulder store furthest displaced laterally from the interfering store, and ℄ Store is the MER centerline store, MER Station 1 or 2.

4.6.3.1 Slope Prediction

The equations governing the prediction of incremental rolling moment variation with angle of attack are presented below.

INTERFERING STORES CARRIED INBOARD

MER STATIONS 1,2,3,4,5 and 6 (MS1-6):

AT A GIVEN MACH NUMBER:

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{\substack{INTF\\MS1-6}}} = \left(\sum \Delta C_{\ell_{\alpha_{\substack{INTF\\IB\to OB\\MS1-6}}}}\right) K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\alpha_{\substack{INTF \\ IB \to OB}}}}$ - Incremental rolling moment slope coefficient due to inboard to outboard interference as a function of y_{INTF}, $\frac{1}{deg}$, see Table 25.

$K_{SCALE_{RM}}$ - Rolling moment scale factor, ft^3., see Subsection 4.6.2.

INTERFERING STORES CARRIED OUTBOARD

MER STATIONS 1,2,3,4,5 and 6 (MS1-6):

AT A GIVEN MACH NUMBER:

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{\substack{INTF \\ MS1-6}}} = \Delta C_{\ell_{\alpha_{\substack{INTF \\ OB \to IB \\ MS1-6}}}} \cdot K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\alpha_{\substack{INTF \\ OB \to IB}}}}$ - Incremental rolling moment slope coefficient due to outboard to inboard interference as a function of y_{INTF}, $\frac{1}{deg}$, See Table 25.

$K_{SCALE_{RM}}$ - Rolling moment scale factor, ft^3., see Subsection 4.6.2.

INTERFERING STORES CARRIED INBOARD AND OUTBOARD

MER STATIONS 1,2,3,4,5 and 6 (MS1-6):

AT A GIVEN MACH NUMBER:

$$\Delta\left(\frac{RM}{q}\right)_{\alpha_{\substack{INTF \\ MS1-6}}} = \left[K_{INTC_2} + K_{SLOPE_2}\left(\sum \Delta C_{\ell_{\alpha_{\substack{INTF \\ IB \to OB \\ MS1-6}}}} + \sum \Delta C_{\ell_{\alpha_{\substack{INTF \\ OB \to IB \\ MS1-6}}}}\right)\right] K_{SCALE_{RM}}$$

where:

K_{INTC_2} - Intercept for the inboard-outboard combination correction for rolling moment slope, $\frac{1}{deg}$, Figure 86.

K_{SLOPE_2} - Slope for the inboard-outboard combination correction for rolling moment slope, Figure 867.

$\Delta C_{\ell_{\alpha_{INTF\ IB \to OB}}}$ - Previously defined.

$\Delta C_{\ell_{\alpha_{INTF\ OB \to IB}}}$ - Previously defined.

$K_{SCALE_{RM}}$ - Rolling moment scale factor, ft^3, see Subsection 4.6.2.

The above equations define the interference increment calculation at a given Mach number. For Mach numbers other than those presented, M = 0.7, 0.9, 1.05, 1.2, 1.6, these guidelines should be followed. If the subject Mach number is less than M = 0.7, use the value of M = 0.7. For other Mach numbers, linear interpolation should be used between the Mach numbers which are presented.

TABLE 25. INCREMENTAL ROLLING MOMENT SLOPE COEFFICIENT DUE TO INTERFERENCE - FIGURE LOCATION GUIDE

$\Delta C_{\ell_{\alpha}}$ INTF	MACH NUMBERS 0.7	0.9	1.05	1.2	1.6
	Figure Numbers				
Adj. Shoulder- Fwd. Cluster	852	853	854	855	856
Adj. Shoulder- Aft Cluster	852	853	854	855	856
℄ Store- Fwd. Cluster	857	858	859	860	861
℄ Store- Aft Cluster	857	858	859	860	861
Opposite Shoulder- Fwd. Cluster	862	863	864	865	866
Opposite Shoulder Aft Cluster	862	863	864	865	866

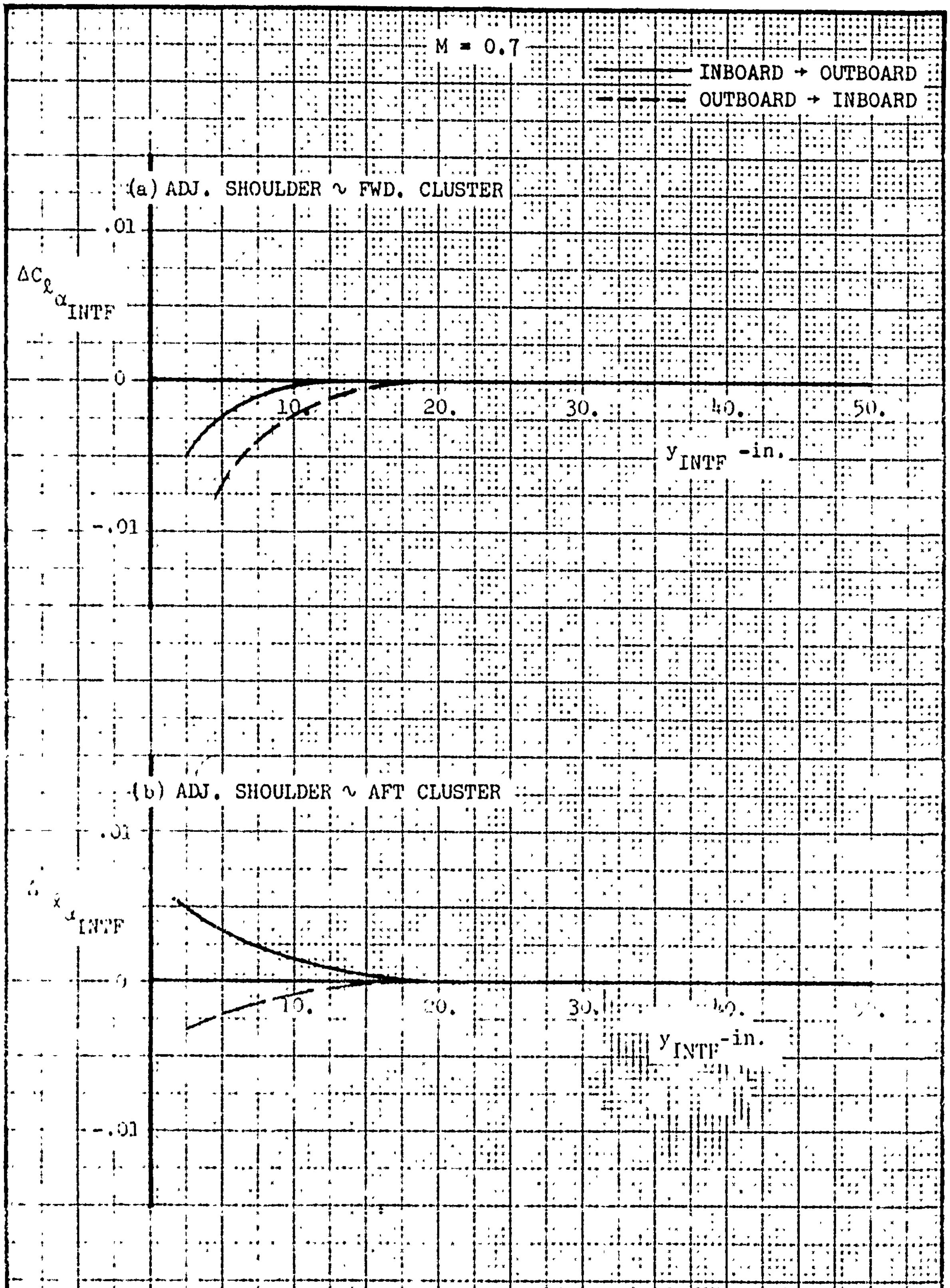


Figure 352. Incremental Rolling Moment Slope Due to Interference - Adjacent Shoulder at M=0.7

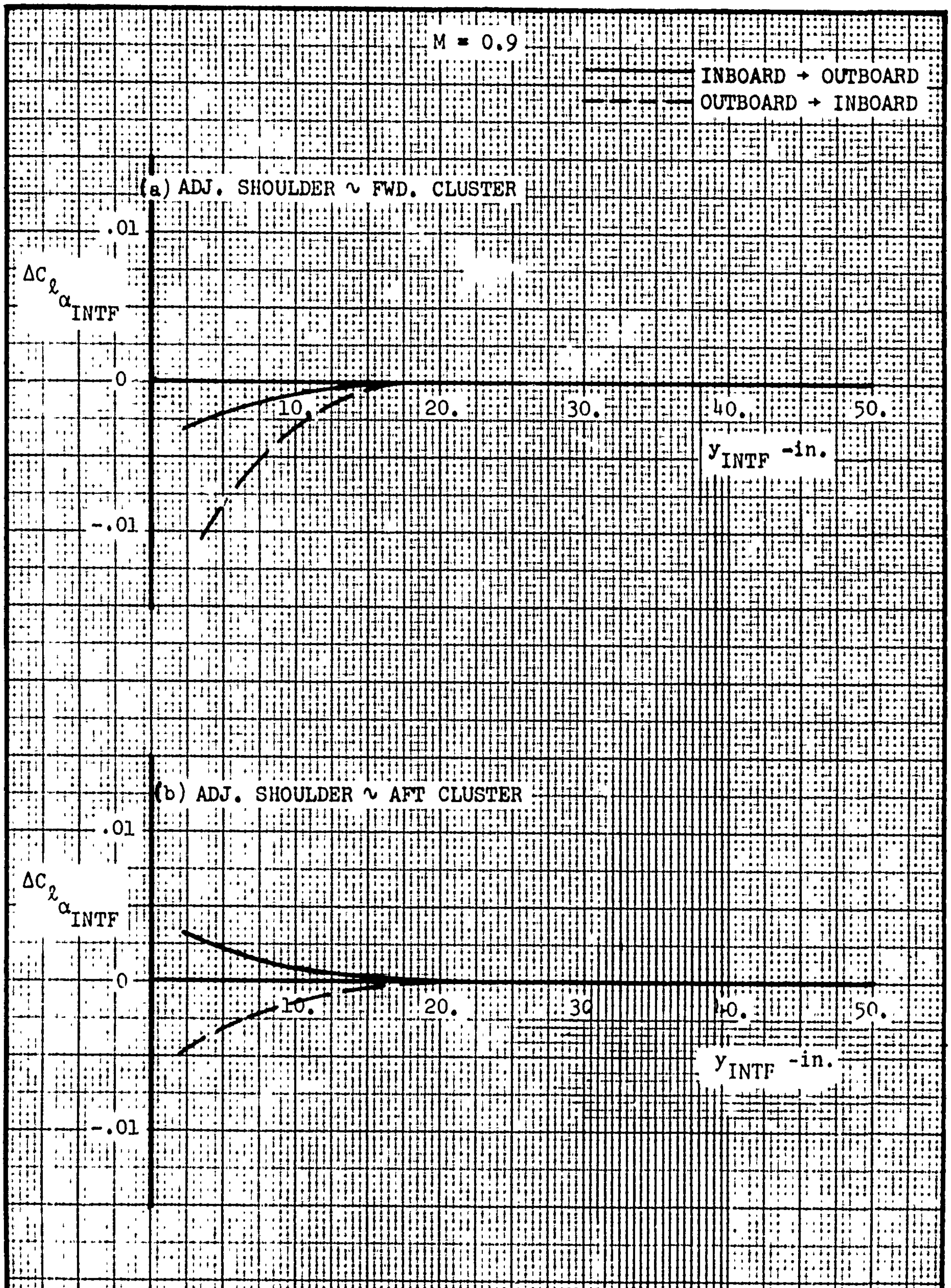


Figure 853. Incremental Rolling Moment Slope Due to Interference - Adjacent Shoulder at M=0.9

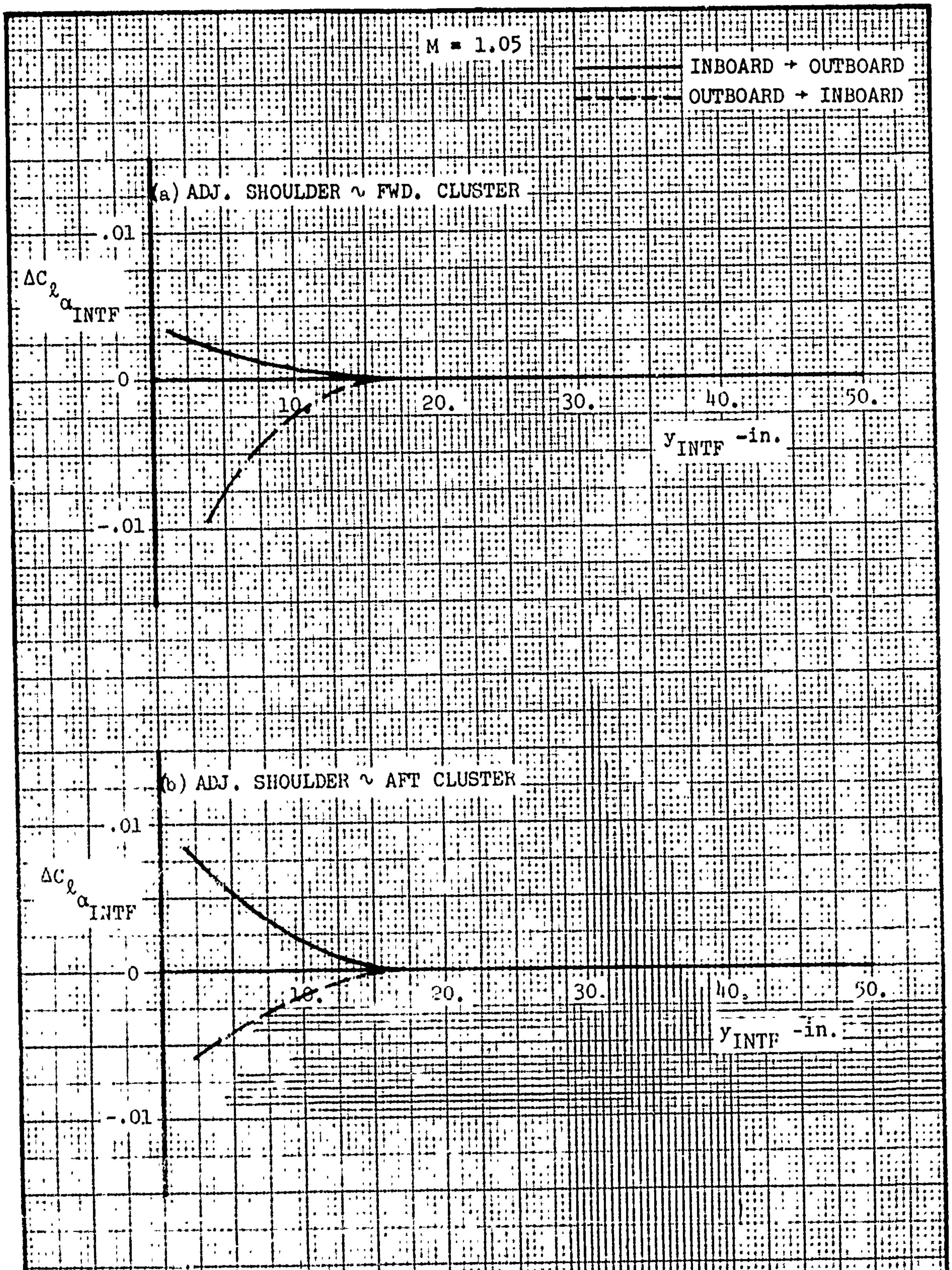


Figure 854. Incremental Rolling Moment Slope Due to Interference - Adjacent Shoulder at M=1.05

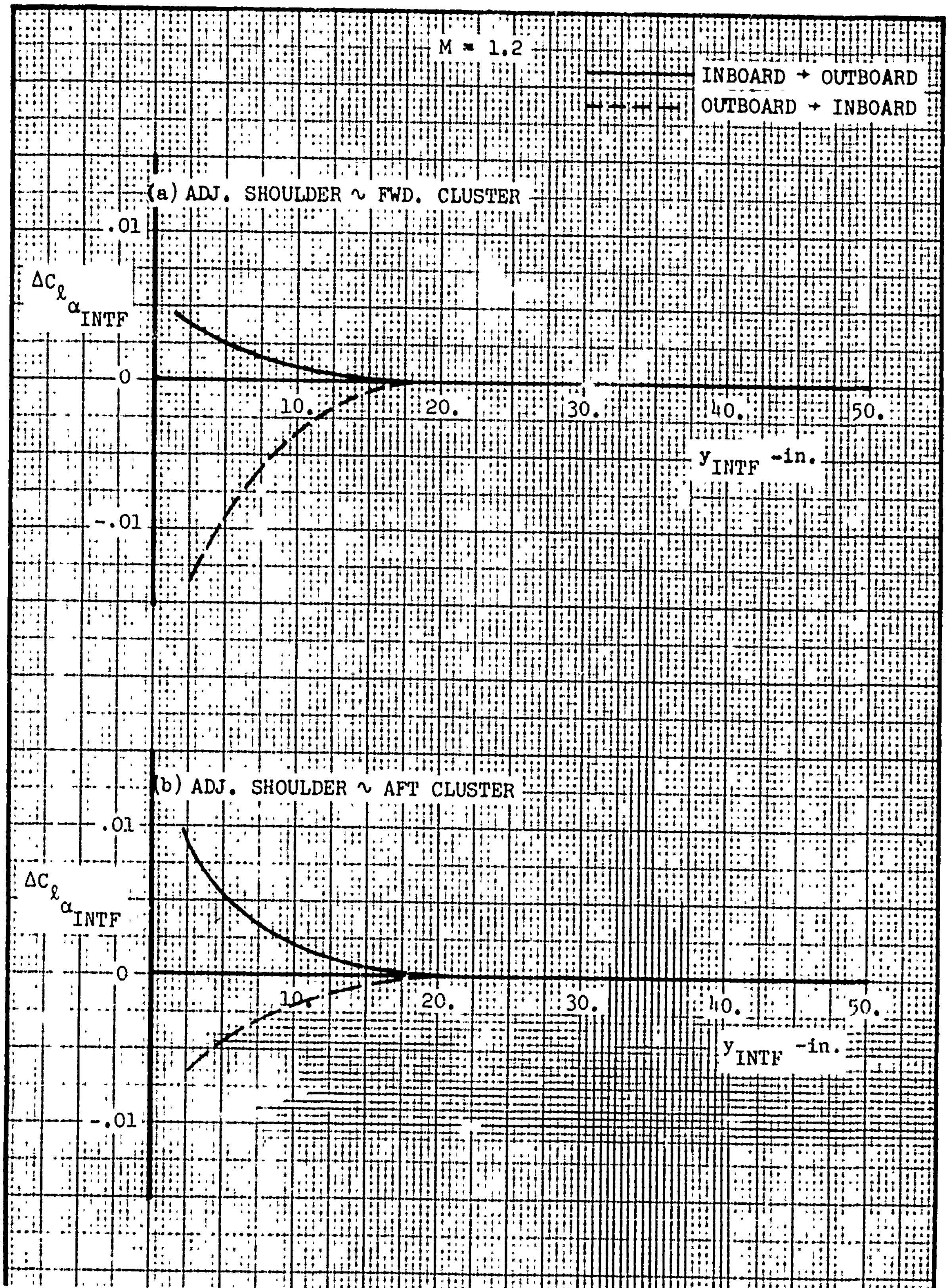


Figure 855. Incremental Rolling Moment Slope Due to Interference - Adjacent Shoulder at M=1.2

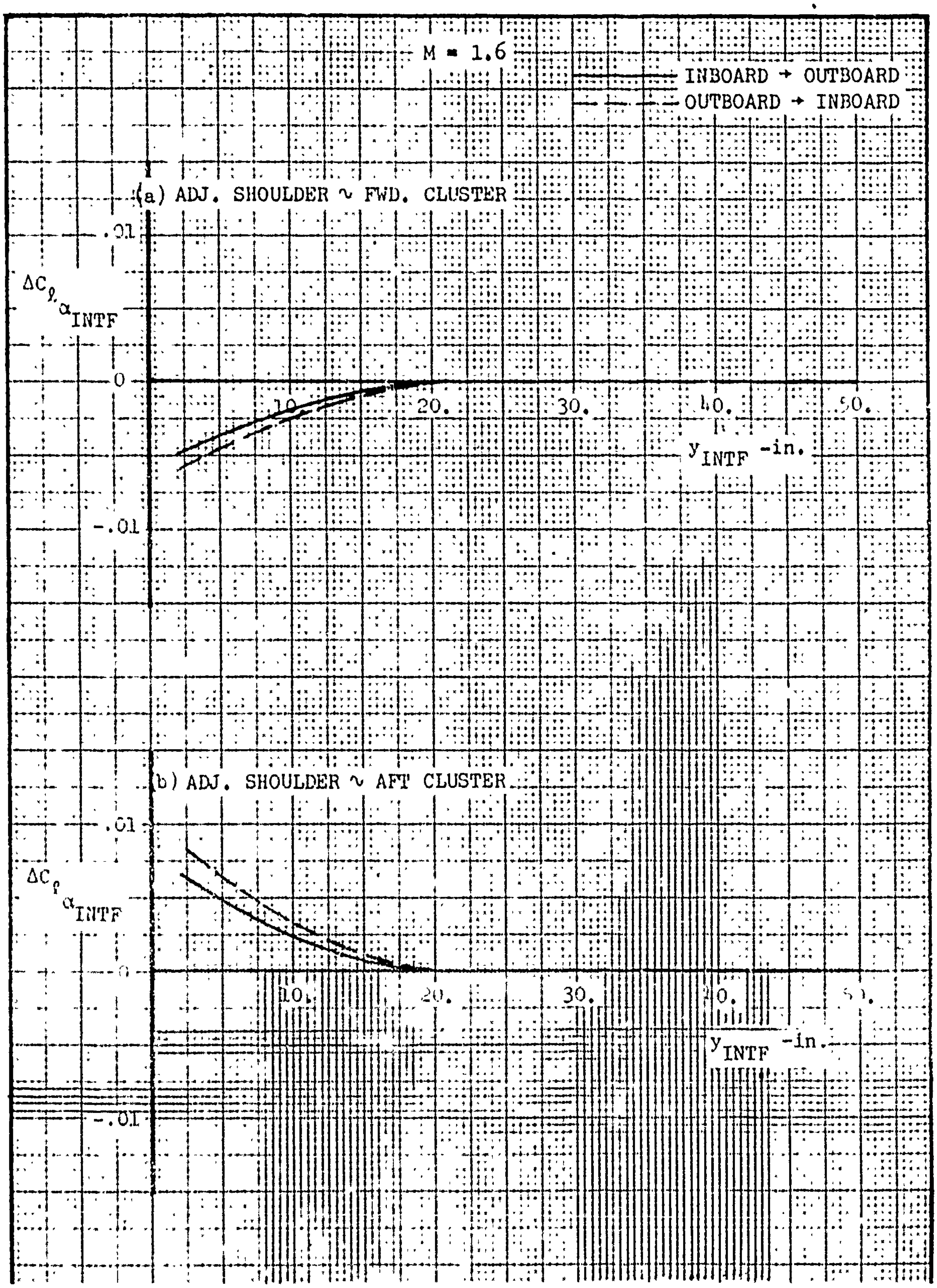


Figure 856. Incremental Rolling Moment Slope Due to Interference - Adjacent Shoulder at M=1.6

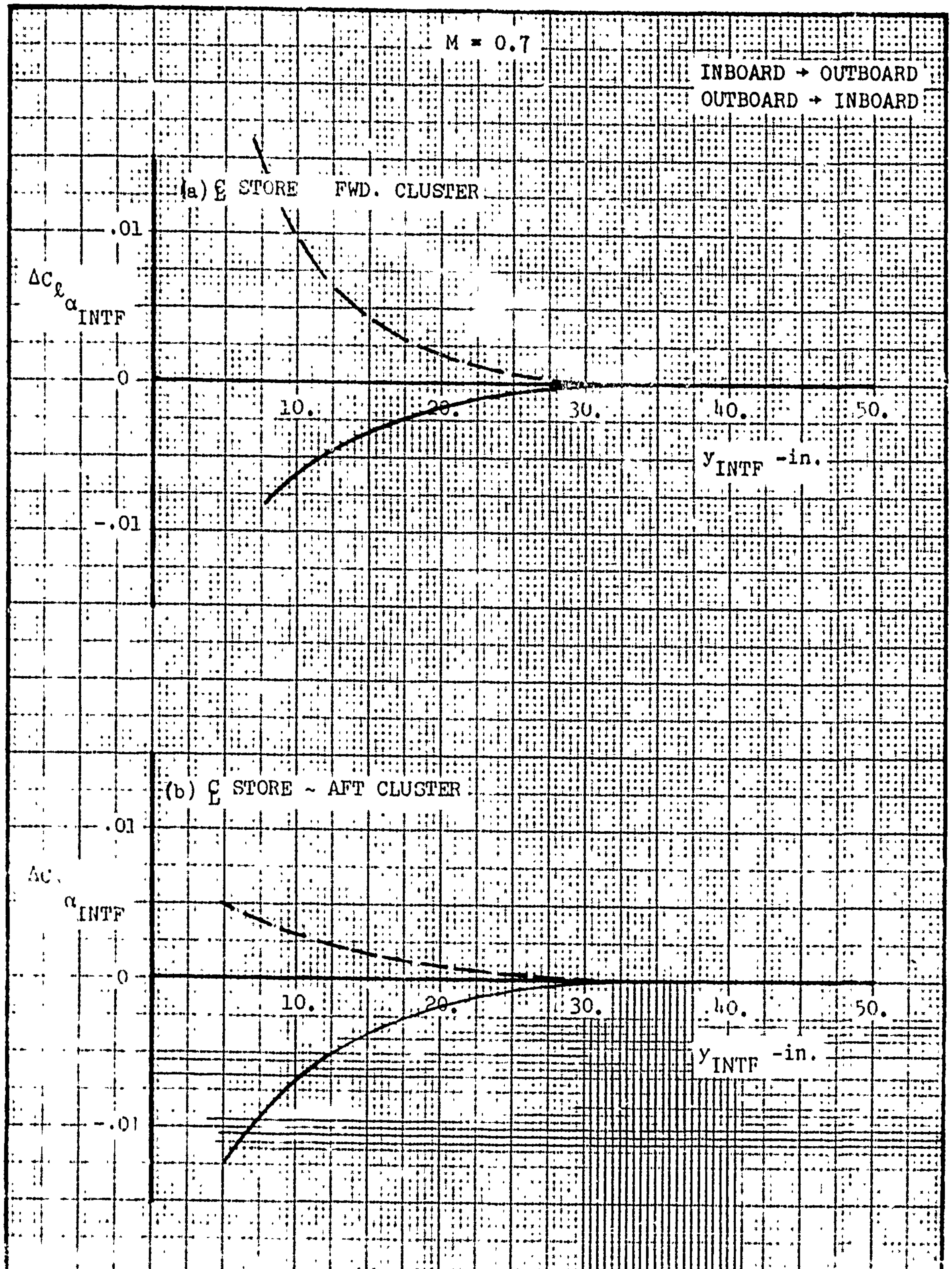


Figure 857. Incremental Rolling Moment Slope Due to Interference - Centerline Store at M=0.7

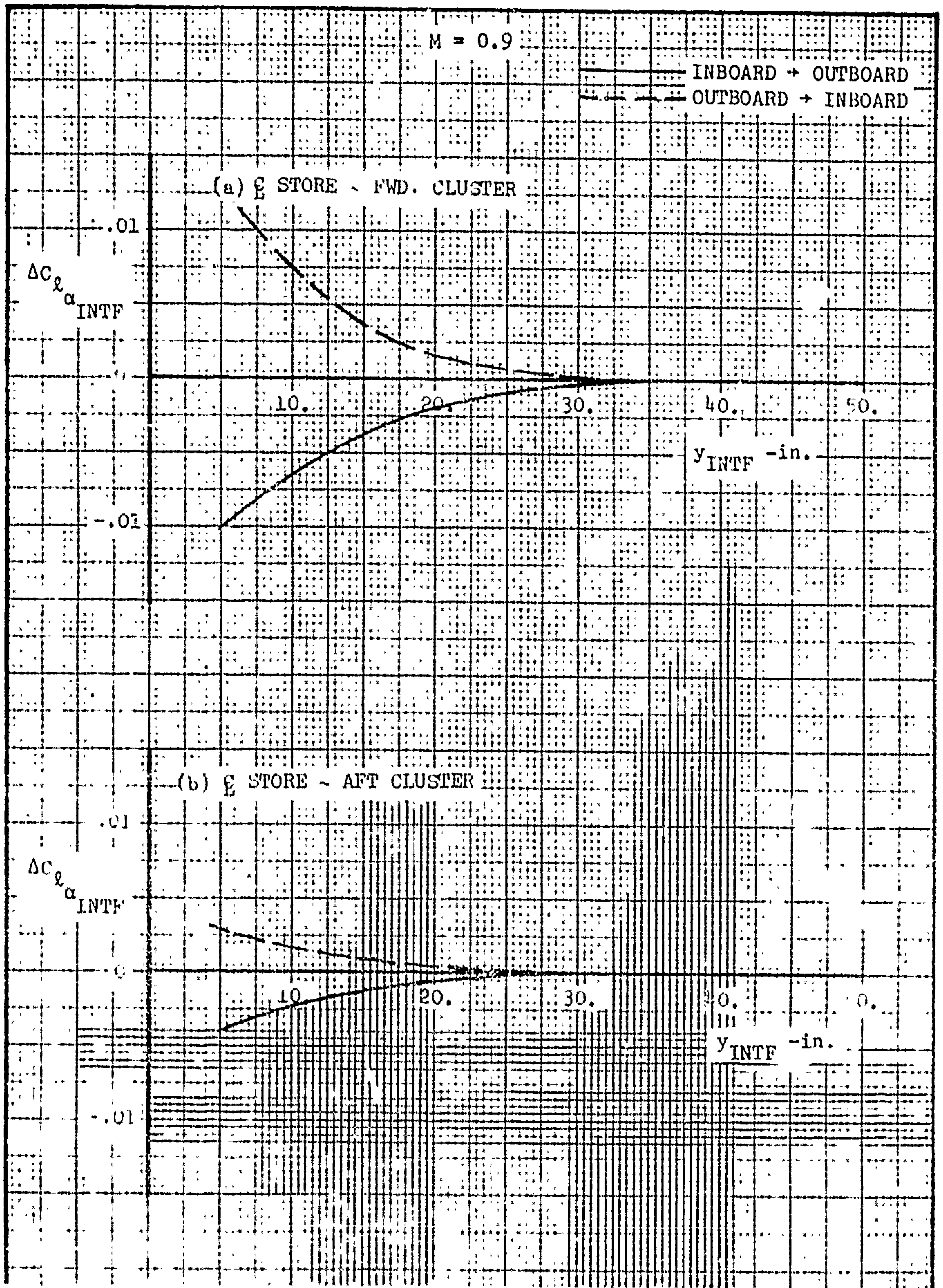


Figure 858. Incremental Rolling Moment Slope Due to Interference - Centerline Store at M=0.9

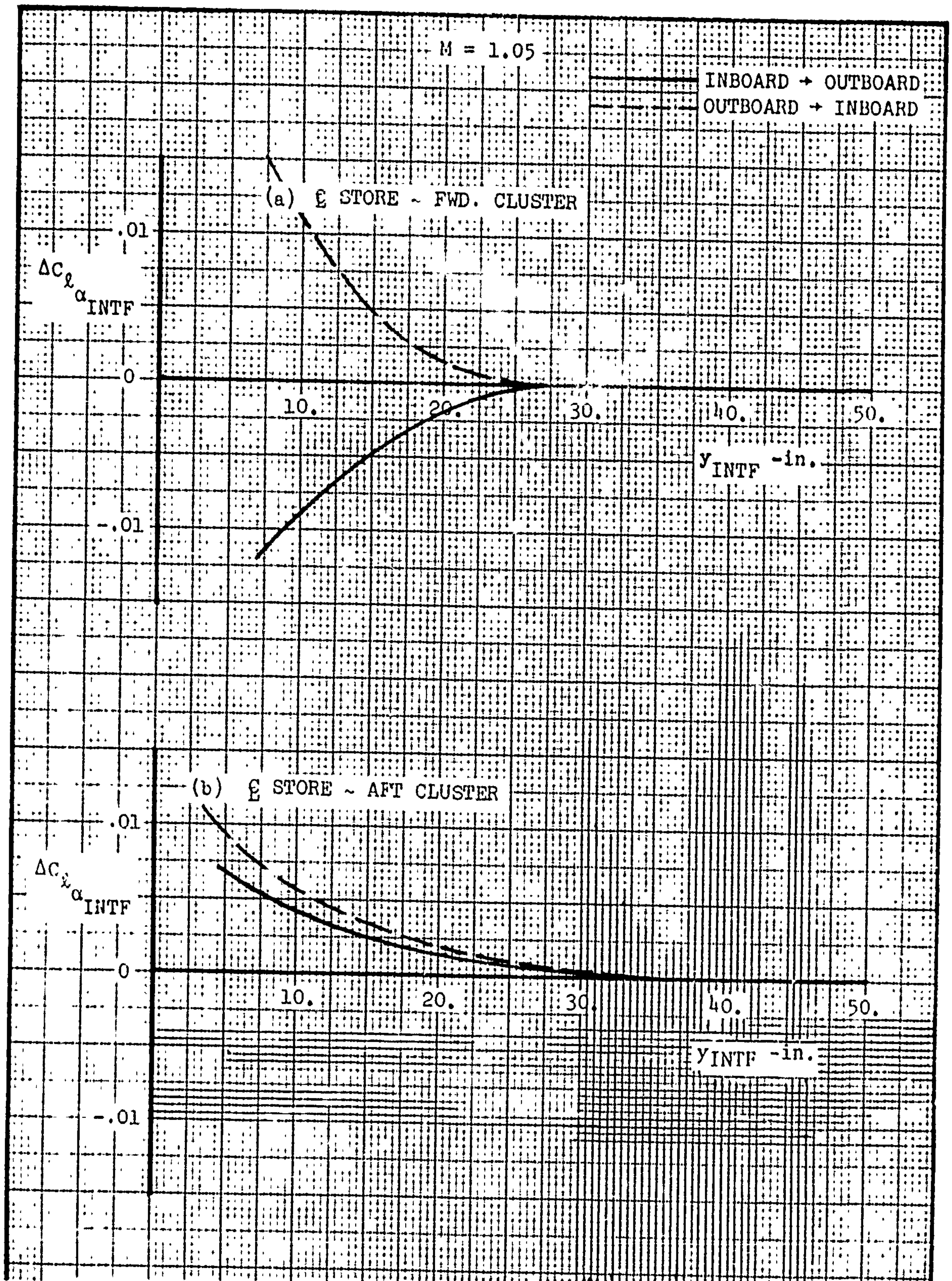


Figure 859. Incremental Rolling Moment Slope Due to Interference - Centerline Store at M=1.05

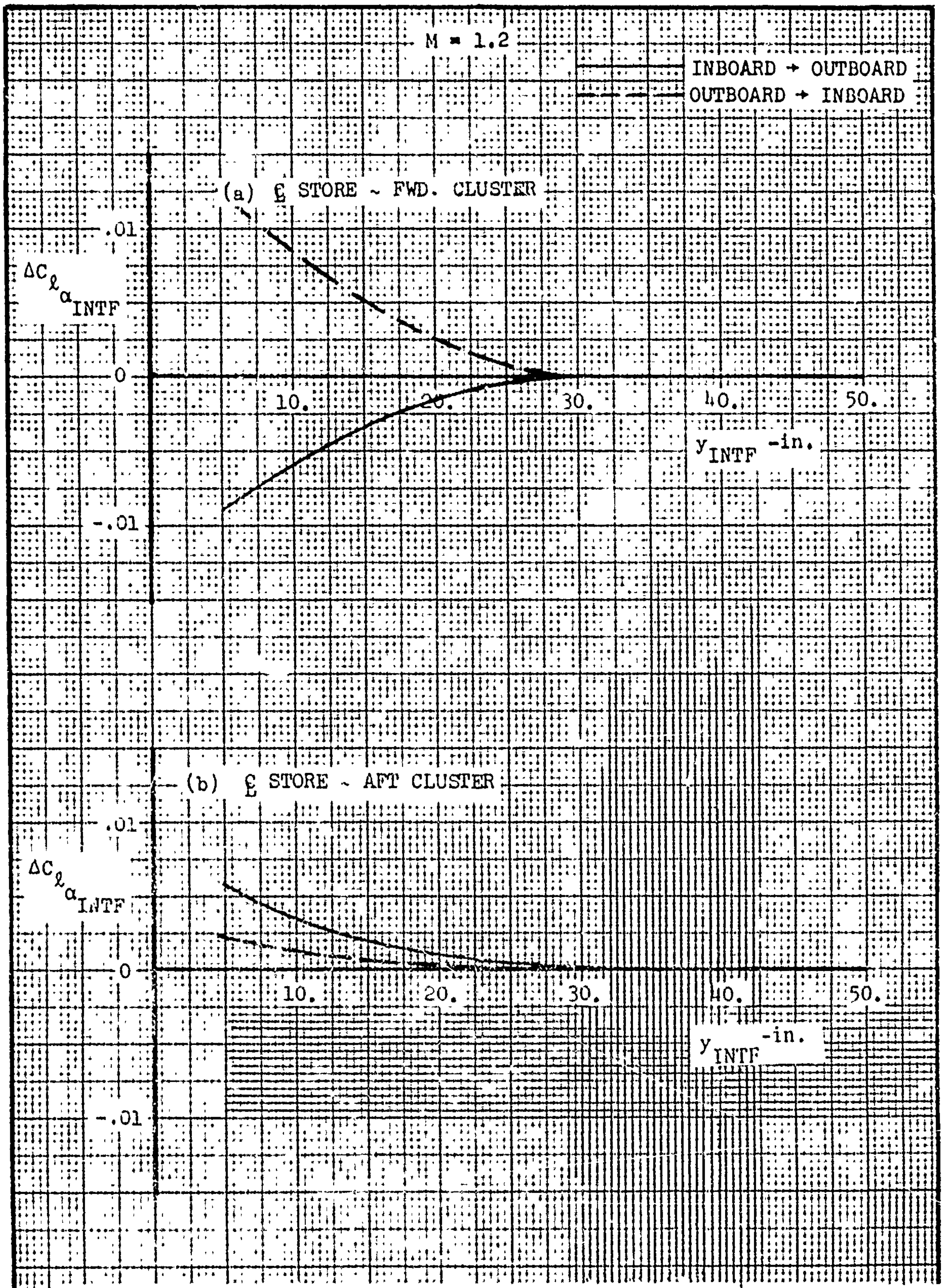


Figure 860. Incremental Rolling Moment Slope Due to Interference - Centerline Store at M=1.2

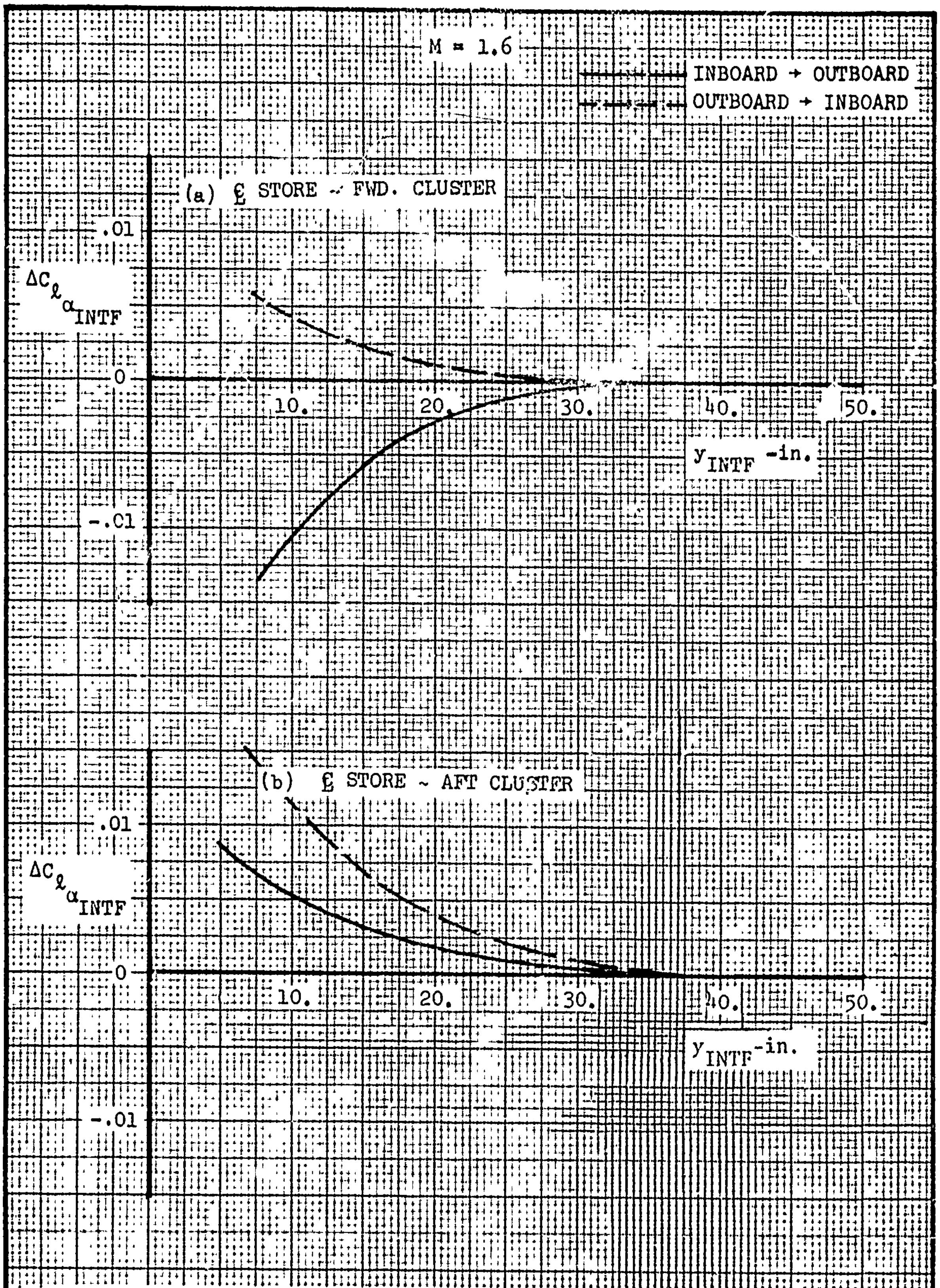


Figure 861. Incremental Rolling Moment Slope Due to Interference - Centerline Store at M=1.6

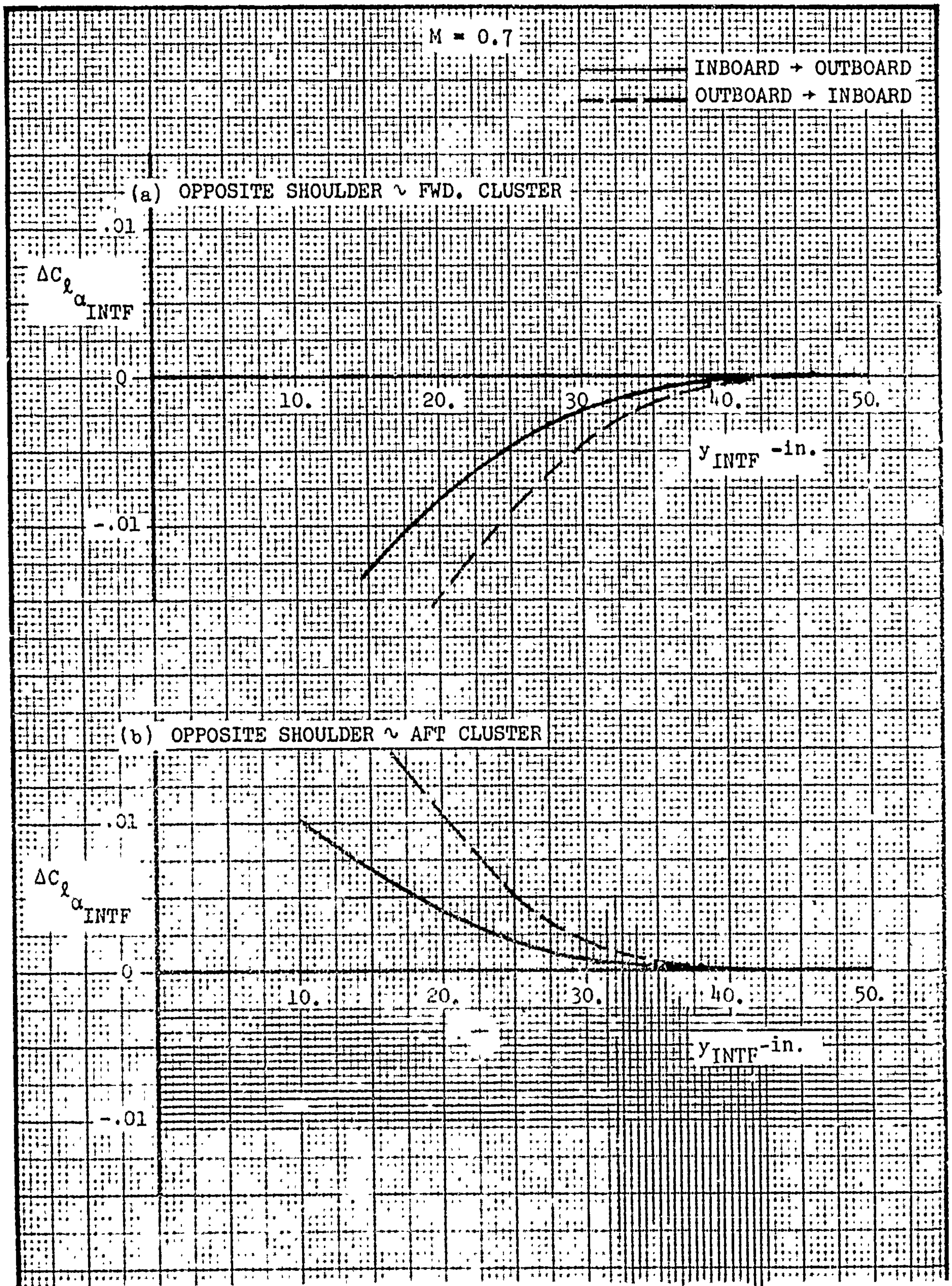


Figure 862. Incremental Rolling Moment Slope Due to Interference - Opposite Shoulder at M=0.7

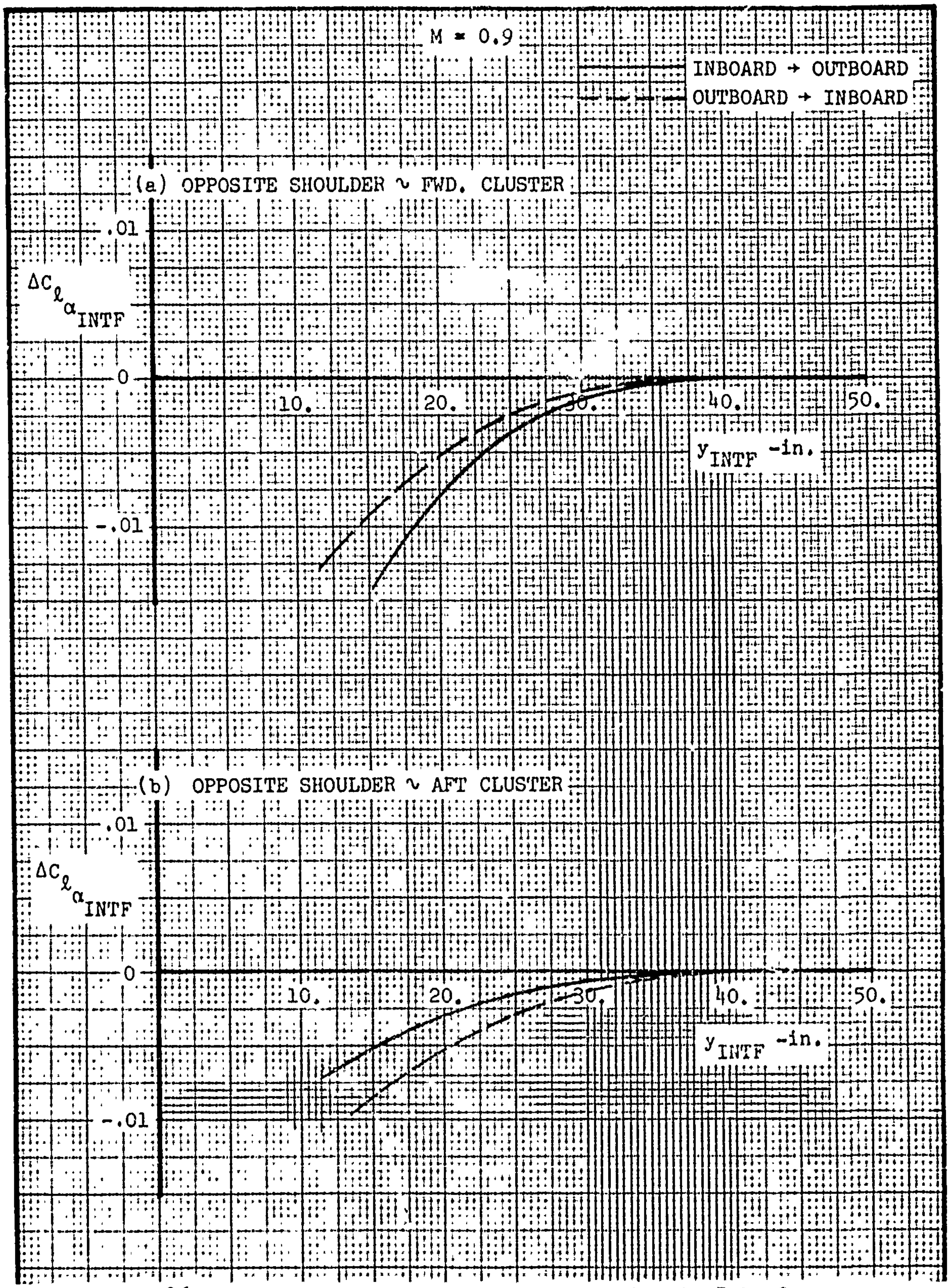


Figure 863. Incremental Rolling Moment Slope Due to Interference - Opposite Shoulder at M=0.9

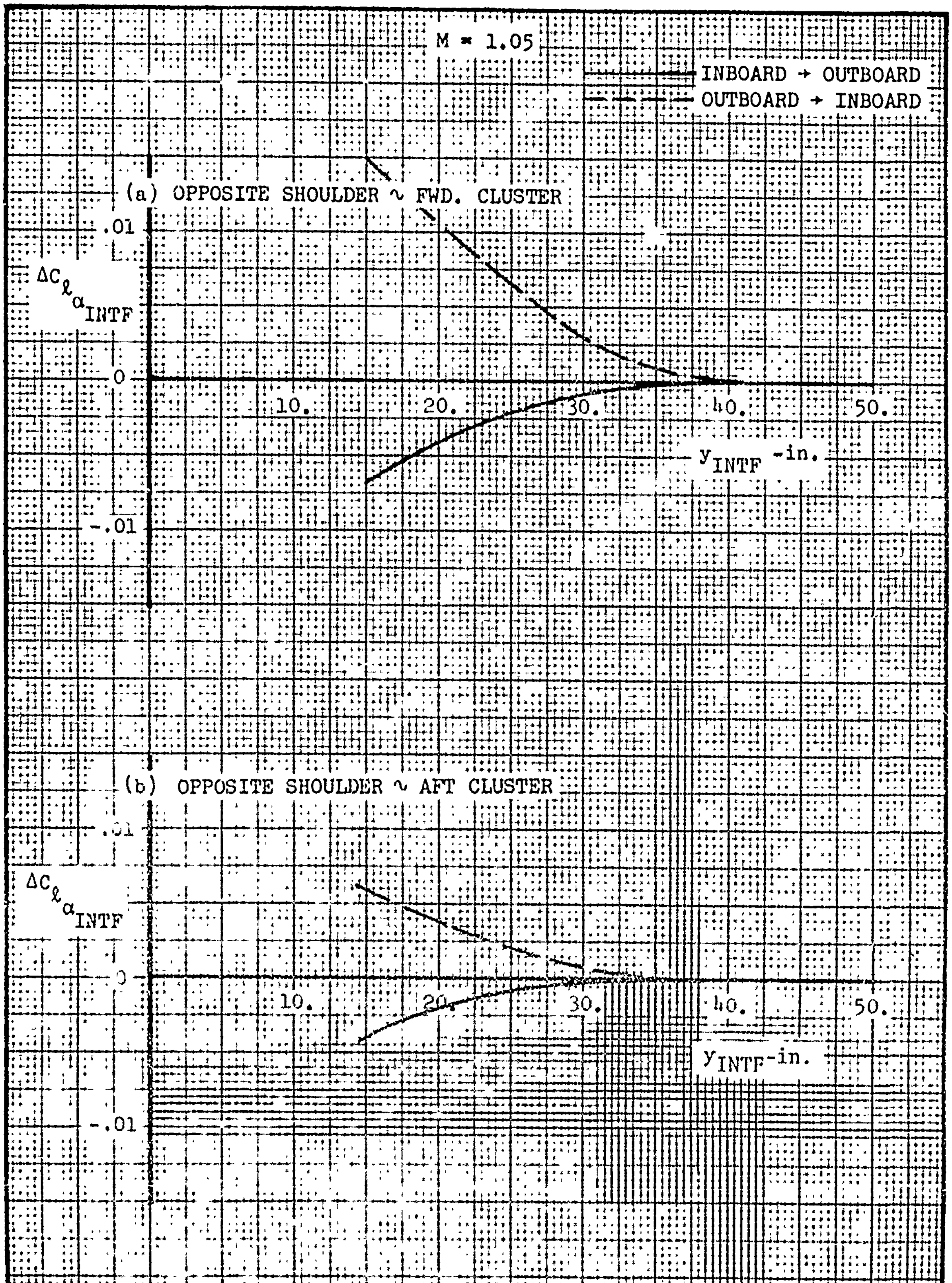


Figure 864. Incremental Rolling Moment Slope Due to Interference - Opposite Shoulder at M=1.05

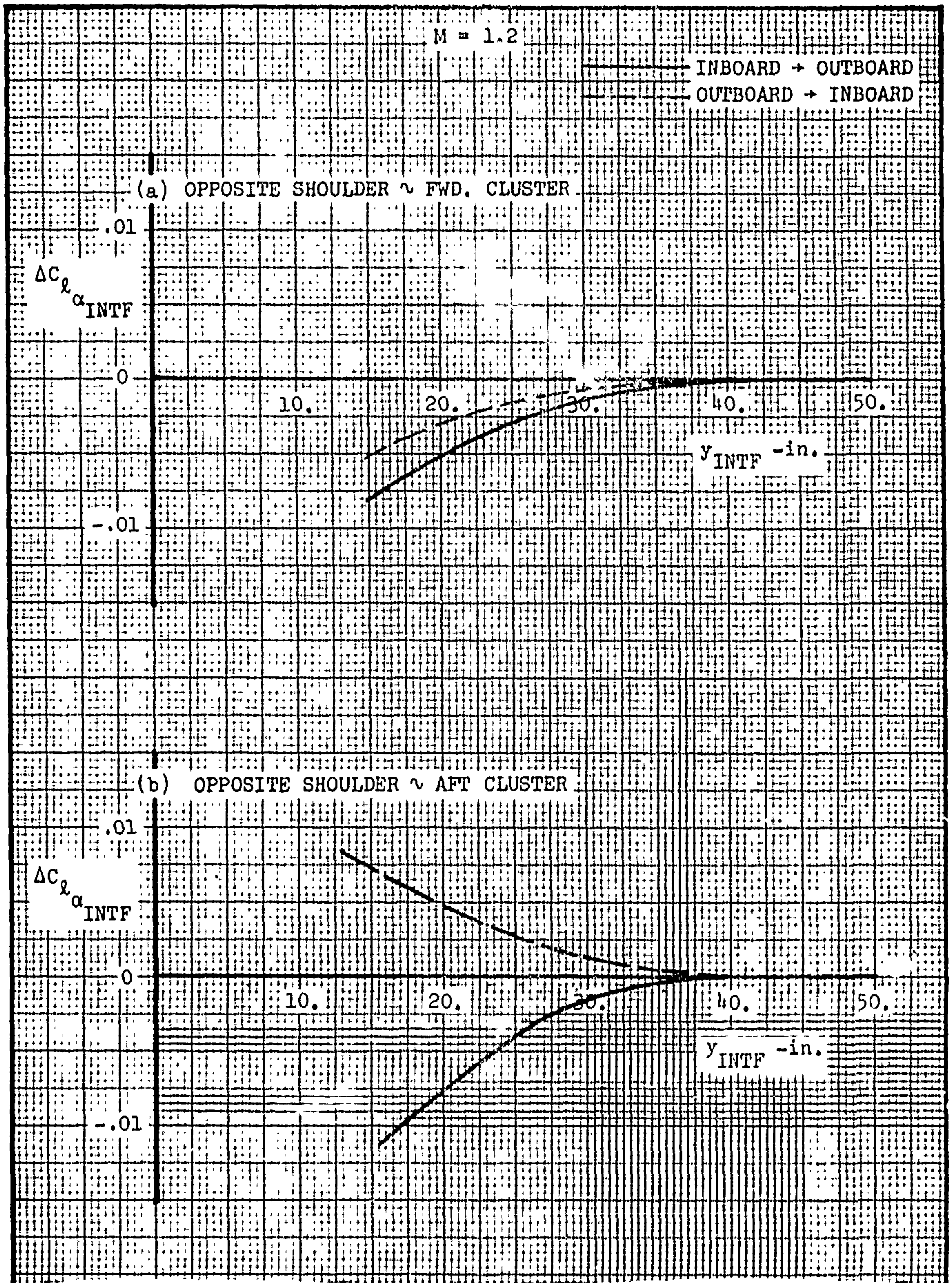


Figure 865. Incremental Rolling Moment Slope Due to Interference - Opposite Shoulder at M=1.2

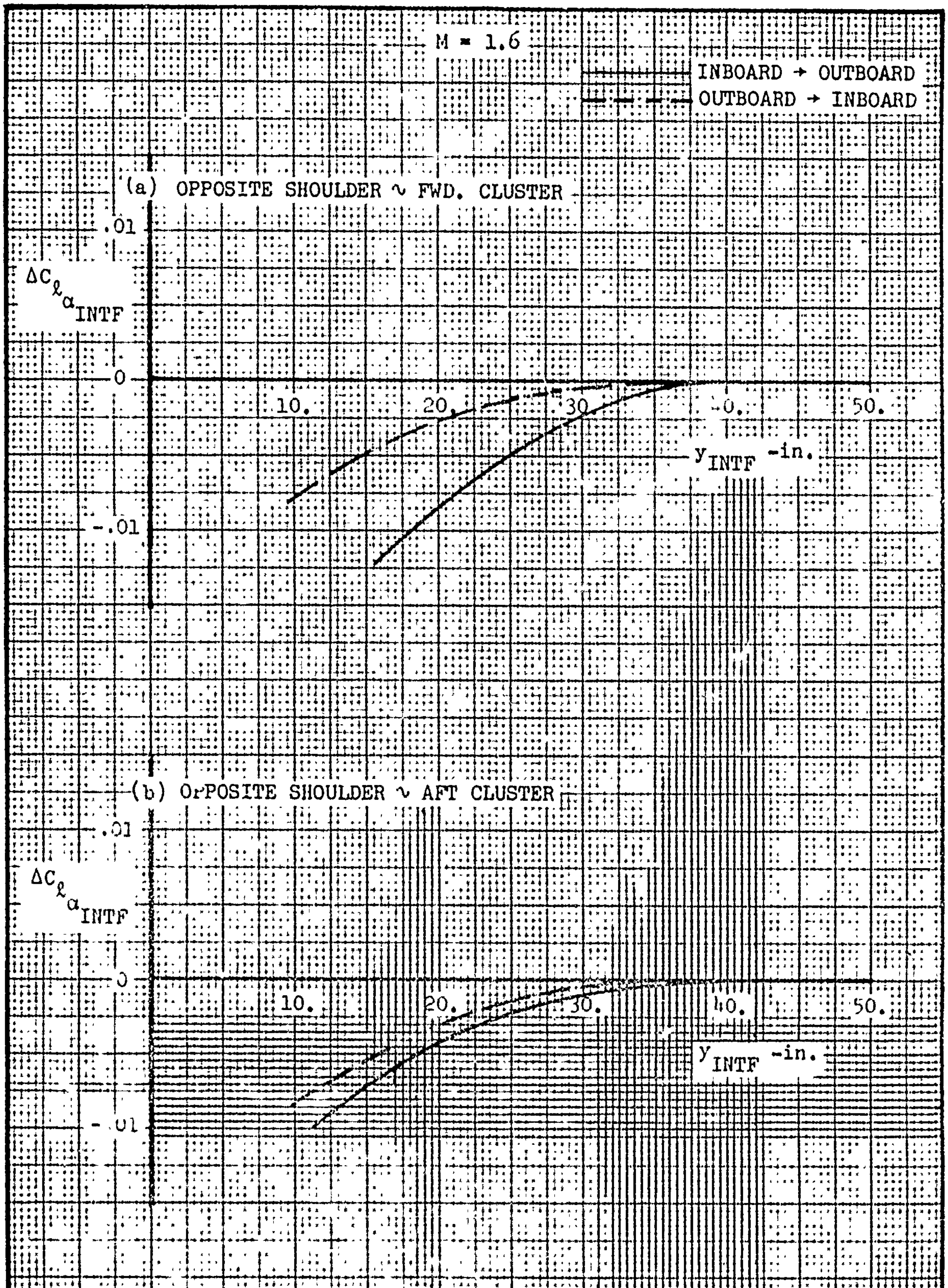


Figure 866. Incremental Rolling Moment Slope Due to Interference - Opposite Shoulder at M=1.6

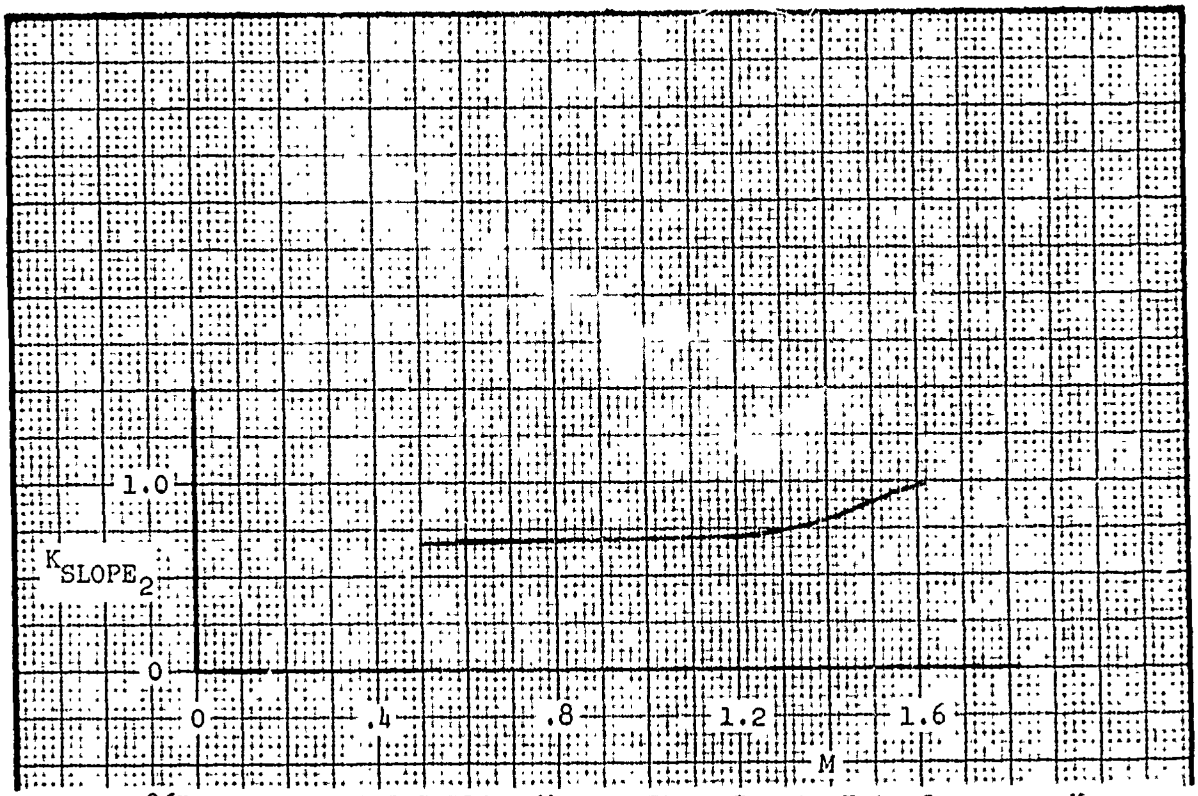


Figure 867. Incremental Rolling Moment Slope Due to Interference - K_{SLOPE_2} for Combination Inboard and Outboard Interference

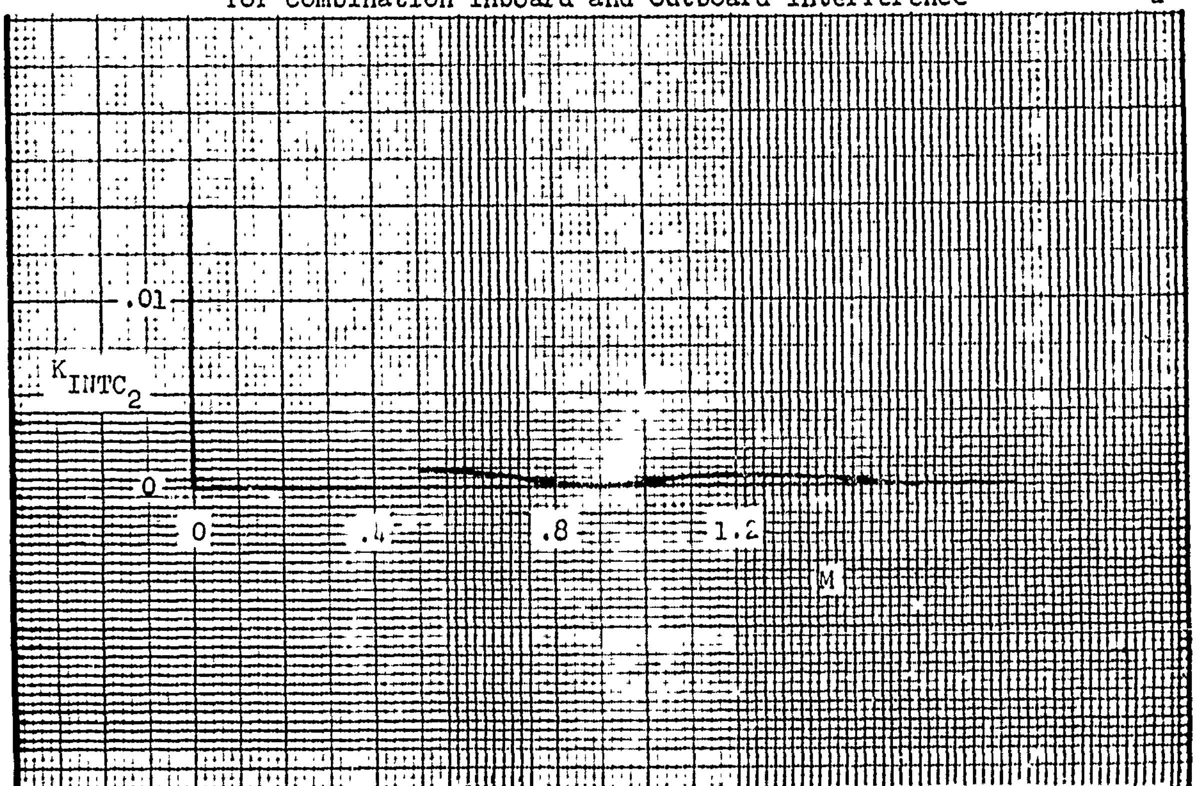


Figure 868. Incremental Rolling Moment Slope Due to Interference - K_{INTC_2} for Combination Inboard and Outboard Interference

4.6.3.2 Intercept Prediction

The equations governing the prediction of incremental rolling moment at α=0 are presented below.

INTERFERING STORES CARRIED INBOARD

MER STATIONS 1,2,3,4,5, and 6 (MS1-6):

AT A GIVEN MACH NUMBER:

$$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\ INTF\\ MS1-6}} = \left(\sum \Delta C_{\ell_{\substack{\alpha=0\\ INTF\\ IB\rightarrow OB\\ MS1-6}}}\right) K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\substack{\alpha=0\\ INTF\\ IB\rightarrow OB}}}$ - Incremental rolling moment intercept coefficient due to inboard to outboard interference as a function of y_{INTF}, see Table 26.

$K_{SCALE_{RM}}$ - Rolling moment scale factor, ft^3 , see Subsection 4.6.2.

INTERFERING STORES CARRIED OUTBOARD

MER STATIONS 1,2,3,4,5, and 6 (MS1-6):

AT A GIVEN MACH NUMBER:

$$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\ INTF\\ MS1-6}} = \left(\sum \Delta C_{\ell_{\substack{\alpha=0\\ INTF\\ OB\rightarrow IB\\ MS1-6}}}\right) K_{SCALE_{RM}}$$

where:

$\Delta C_{\ell_{\substack{\alpha=0\\ INTF\\ OB\to IB}}}$ - Incremental rolling moment intercept coefficient due to outboard to inboard interference as a function of y_{INTF}, see Table 26.

$K_{SCALE_{RM}}$ - Rolling moment scale factor, ft^3, see Subsection 4.6.2.

INTERFERING STORES CARRIED INBOARD AND OUTBOARD

MER STATIONS 1,2,3,4,5, and 6 (MS1-6):

AT A GIVEN MACH NUMBER:

$$\Delta\left(\frac{RM}{q}\right)_{\substack{\alpha=0\\ INTF\\ MS1-6}} = \left[K_{INTC_1} + K_{SLOPE_1}\left(\sum \Delta C_{\ell_{\substack{\alpha=0\\ INTF\\ IB\to OB\\ MS1-6}}} + \sum \Delta C_{\ell_{\substack{\alpha=0\\ INTF\\ OB\to IB\\ MS1-6}}}\right)\right] K_{SCALE_{RM}}$$

where:

K_{INTC_1} - Intercept for the inboard - outboard combination correction for rolling moment intercept, Figure 885.

K_{SLOPE_1} - Slope for the inboard - outboard combination correction for rolling moment intercept, Figure 884.

$\Delta C_{\ell_{\substack{\alpha=0\\ INTF\\ IB\to OB}}}$ - Previously defined.

$\Delta C_{\ell_{\substack{\alpha=0\\ INTF\\ OB\to IB}}}$ - Previously defined.

$K_{SCALE_{RM}}$ - Rolling moment scale factor, ft^3 , see Subsection 4.6.2.

The above equations define the interference increment calculation at a given Mach number. For Mach numbers other than those presented, M = 0.7, 0.9, 1.05, 1.2, 1.6, these guidelines should be followed. If the subject Mach number is less than M = 0.7, use the value at M = 0.7. For other Mach numbers linear interpolation should be used between the Mach numbers which are presented.

TABLE 26. INCREMENTAL ROLLING MOMENT INTERCEPT COEFFICIENT DUE TO INTERFERENCE - FIGURE LOCATION GUIDE

$\Delta C_{\ell_{\alpha=0}}$ INTF	MACH NUMBER 0.7	0.9	1.05	1.2	1.6
	Figure Numbers				
Adj. Shoulder-Fwd. Cluster	869	870	871	872	873
Adj. Shoulder-Aft Cluster	869	870	871	872	873
℄ Store-Fwd. Cluster	874	875	876	877	878
℄ Store-Aft Cluster	874	875	876	877	878
Opposite Shoulder-Fwd. Cluster	879	880	881	882	883
Opposite Shoulder-Aft Cluster	879	880	881	882	883

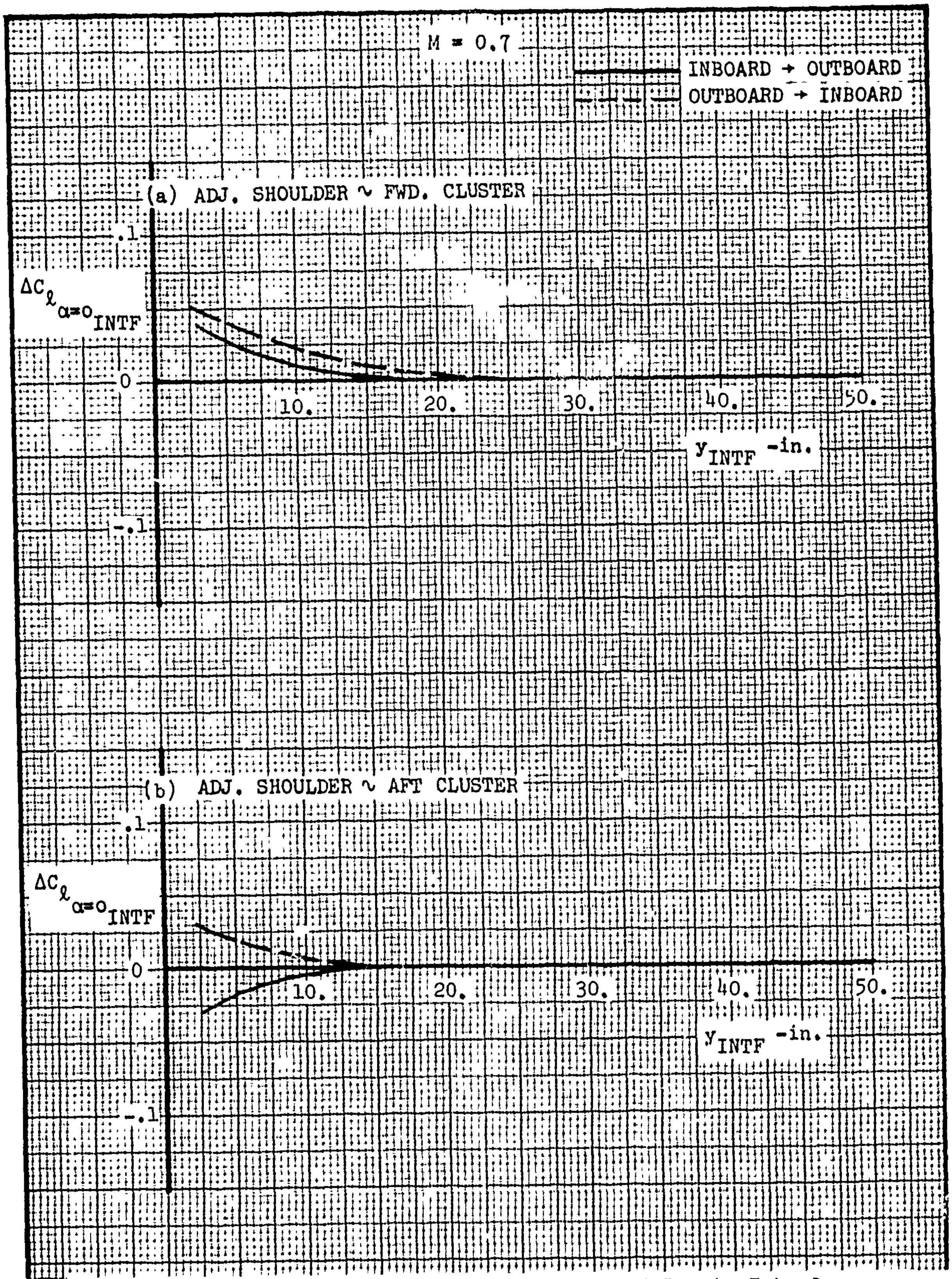


Figure 869. Incremental Rolling Moment Intercept Due to Interference - Adjacent Shoulder at M=0.7

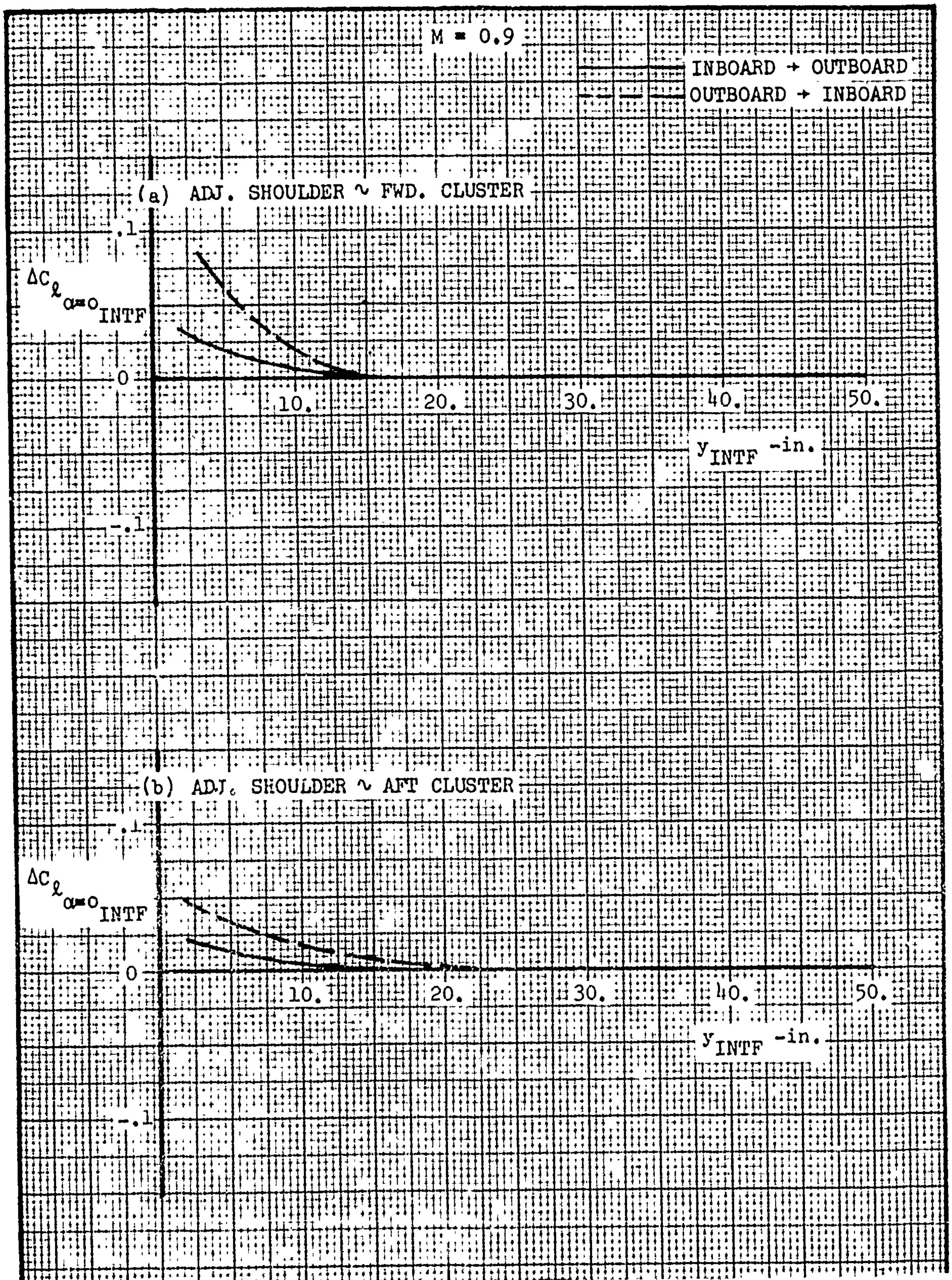


Figure 870. Incremental Rolling Moment Intercept Due to Interference - Adjacent Shoulder at M=0.9

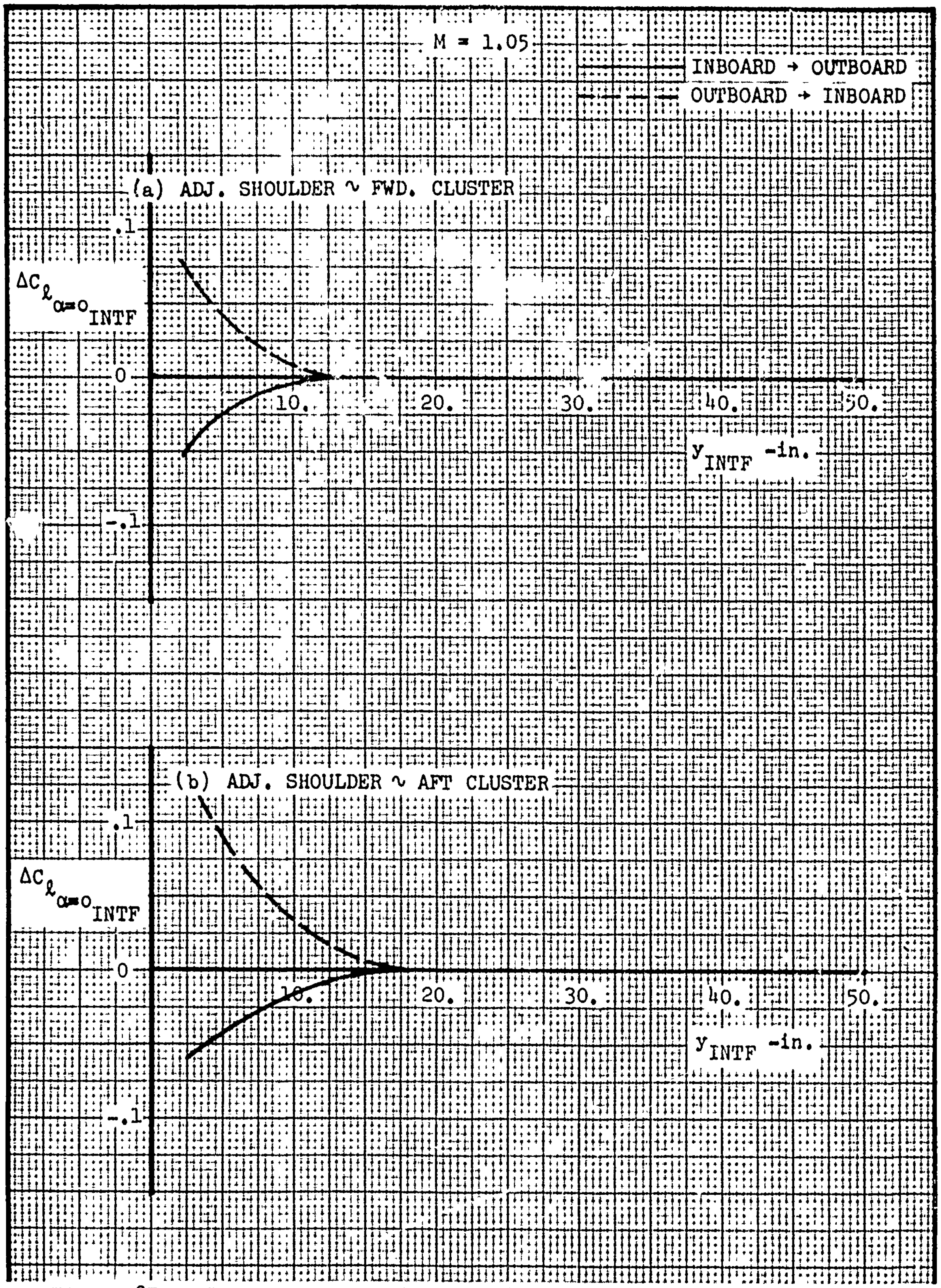


Figure 871. Incremental Rolling Moment Intercept Due to Interference - Adjacent Shoulder at M=1.05

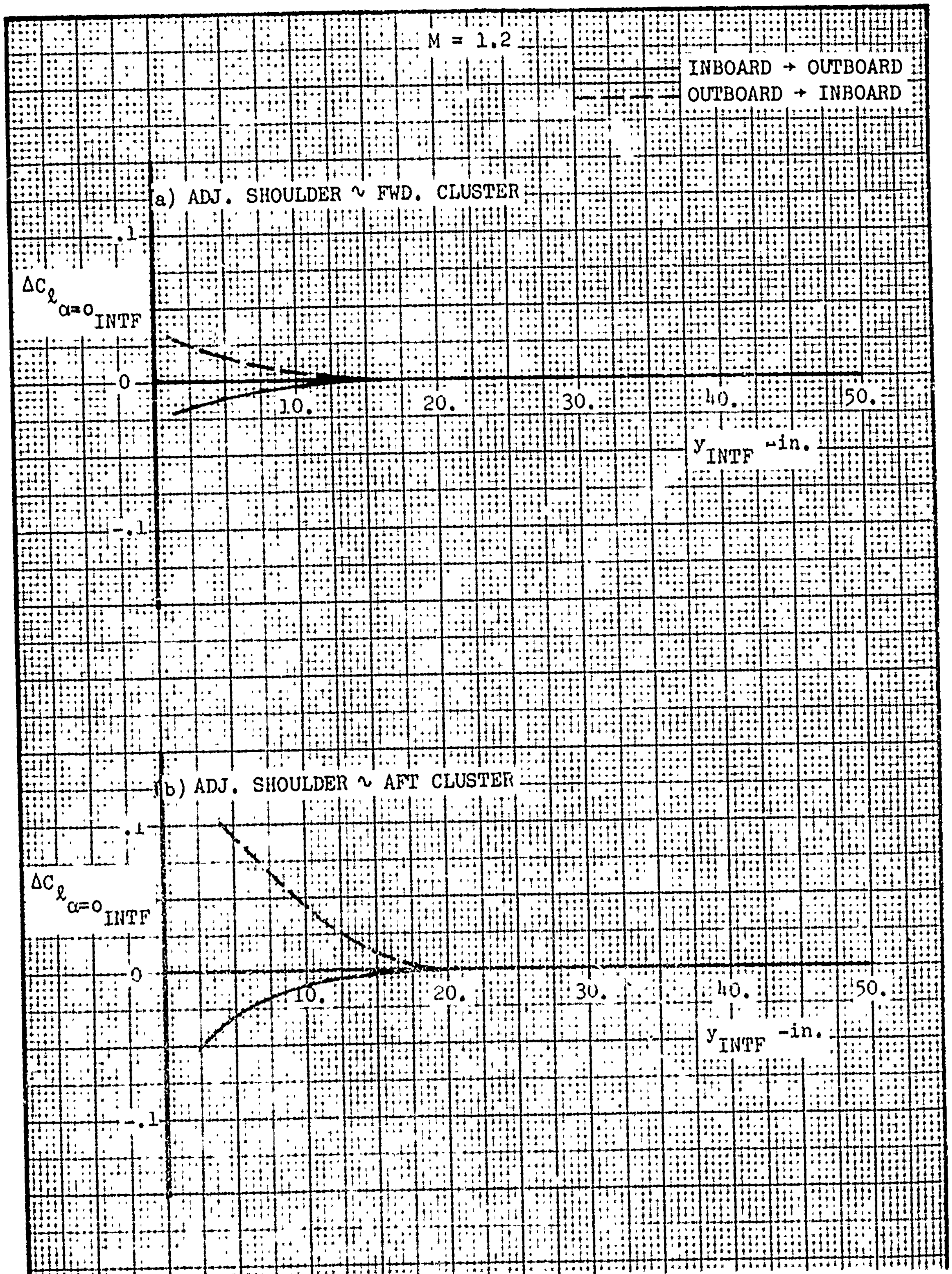


Figure 872. Incremental Rolling Moment Intercept Due to Interference - Adjacent Shoulder at M=1.2

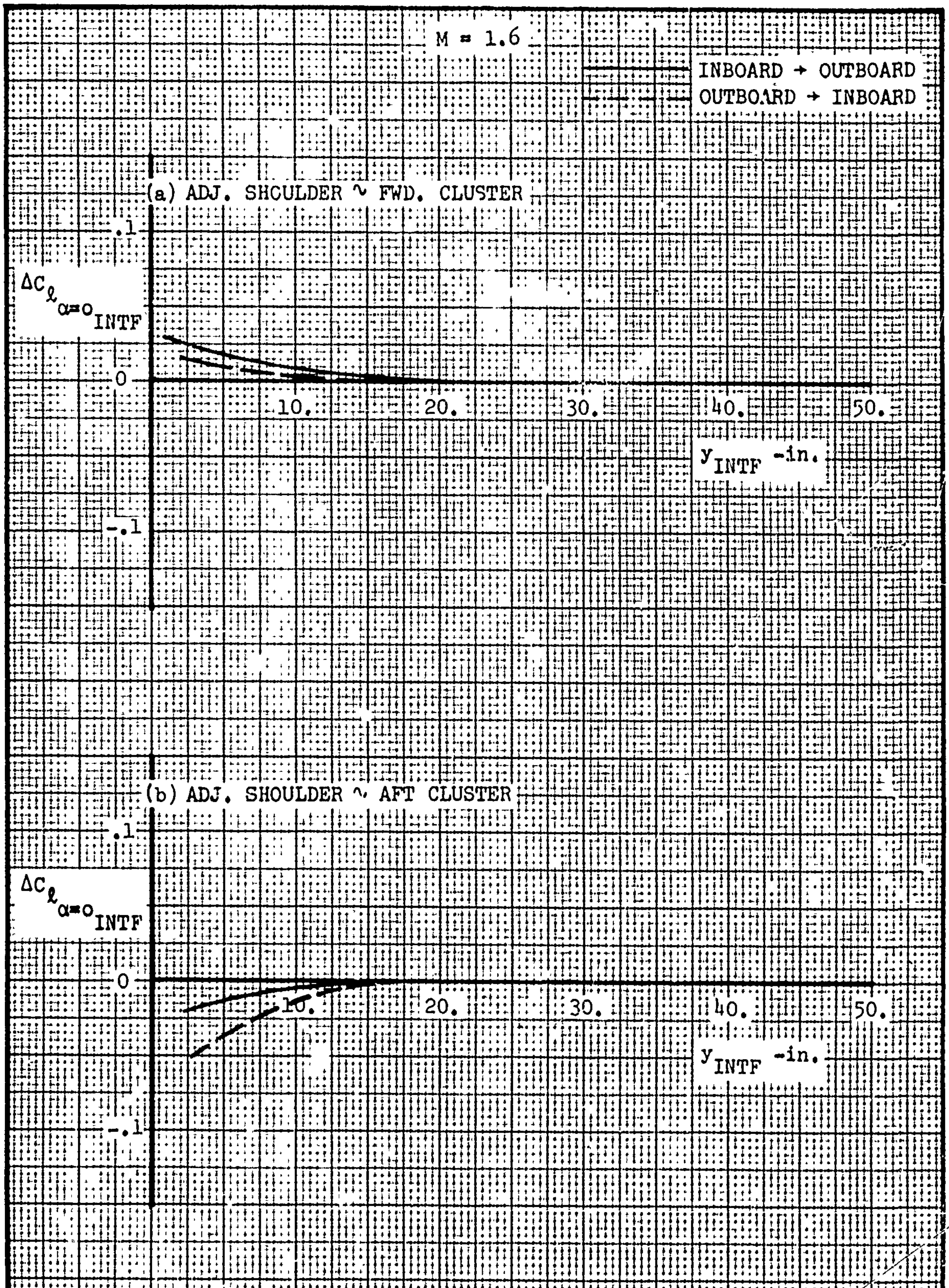


Figure 873. Incremental Rolling Moment Intercept Due to Interference - Adjacent Shoulder at M=1.6

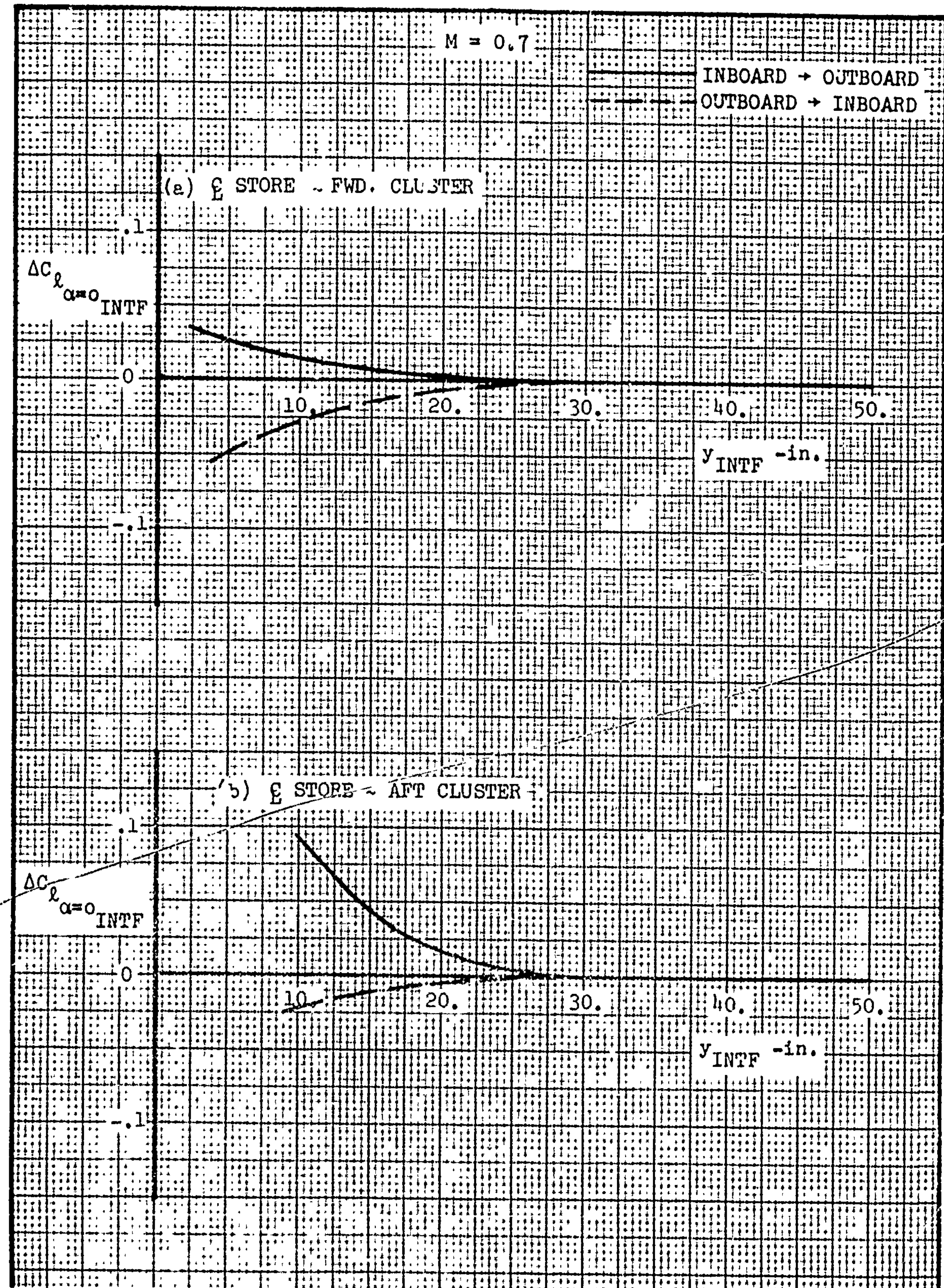


Figure 874. Incremental Rolling Moment Intercept Due to Interference - Centerline Store at M = 0.7

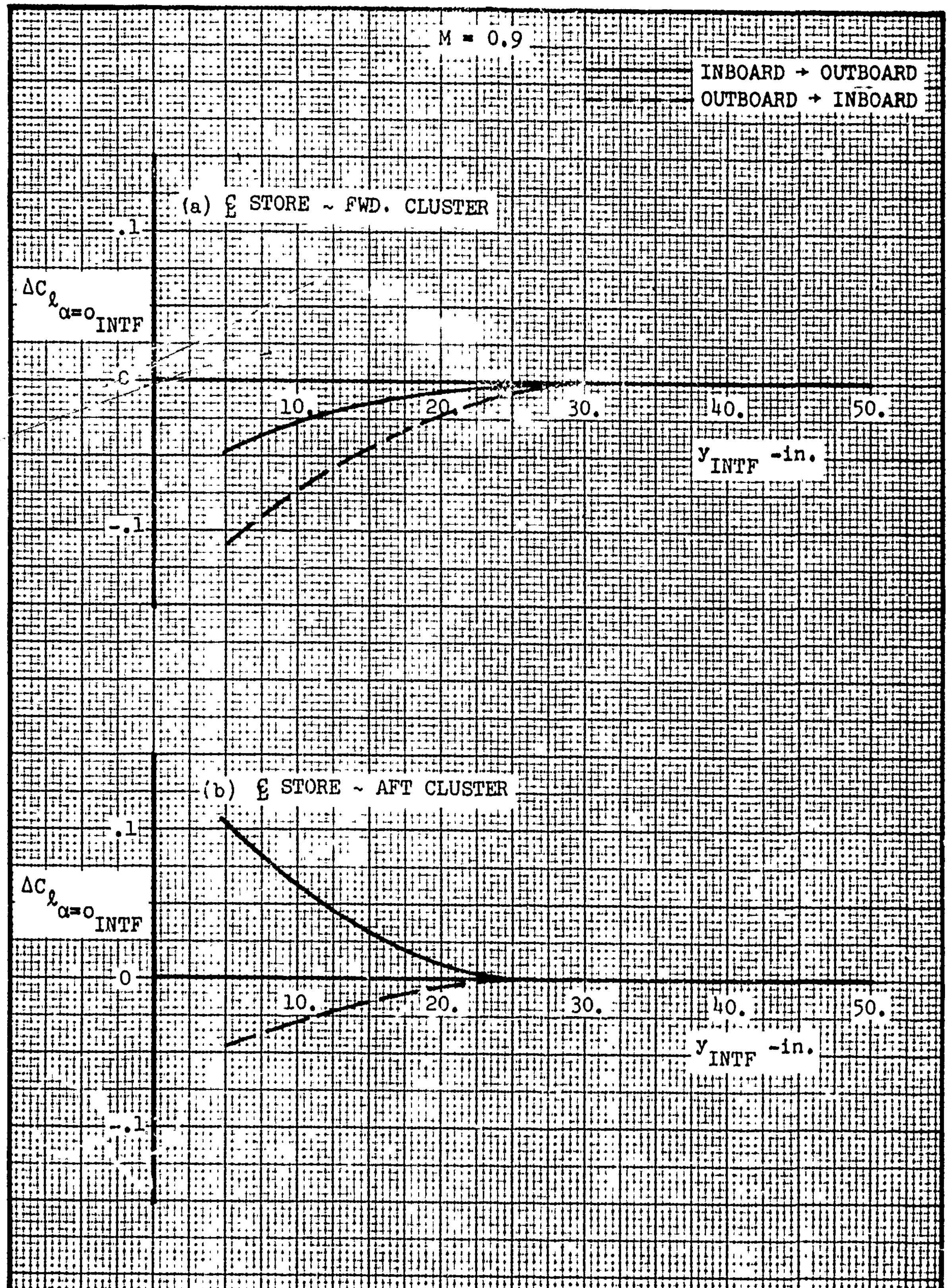


Figure 875. Incremental Rolling Moment Intercept Due to Interference - Centerline Store at M=0.9

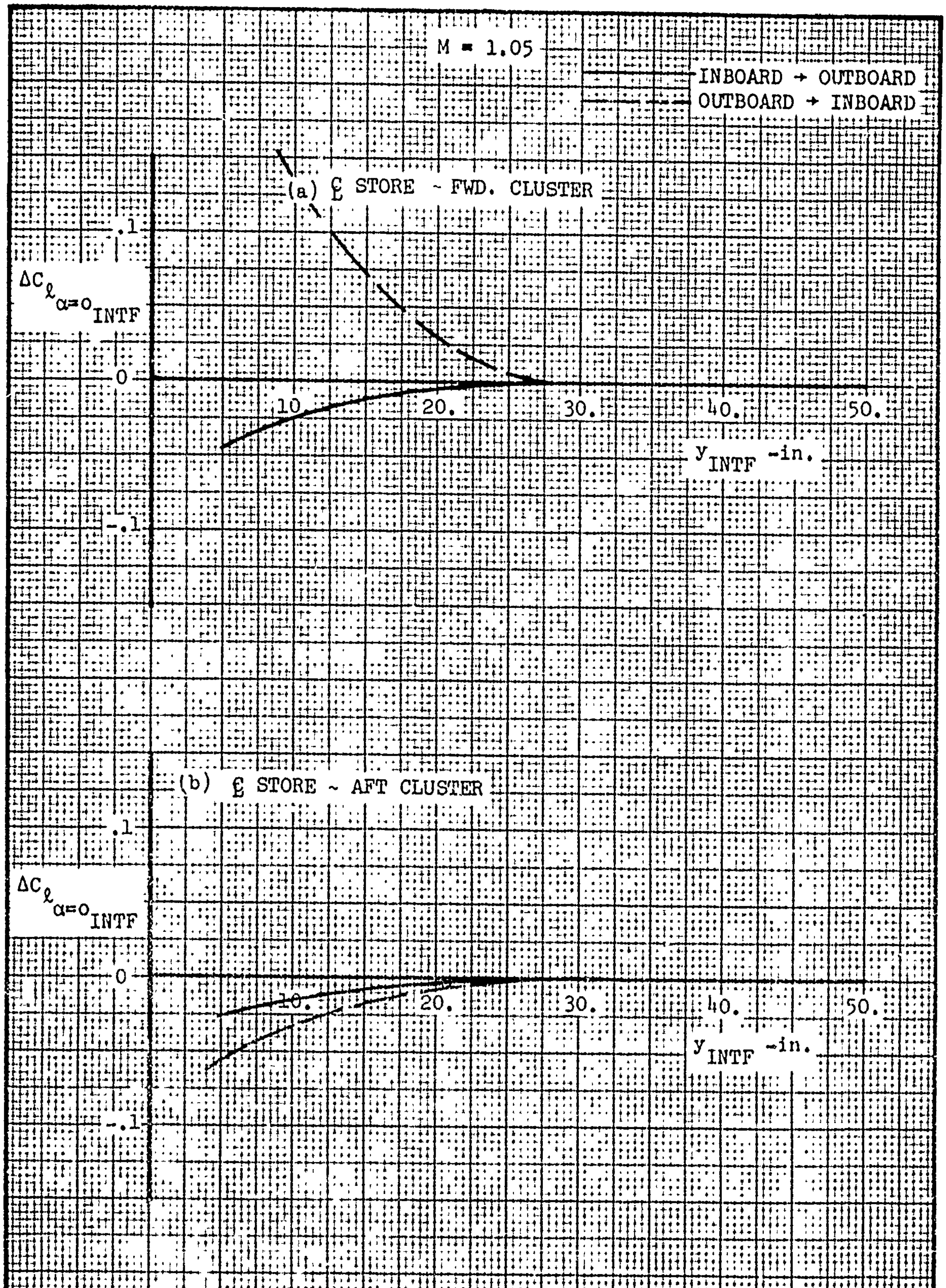


Figure 876. Incremental Rolling Moment Intercept Due to Interference - Centerline Store at M=1.05

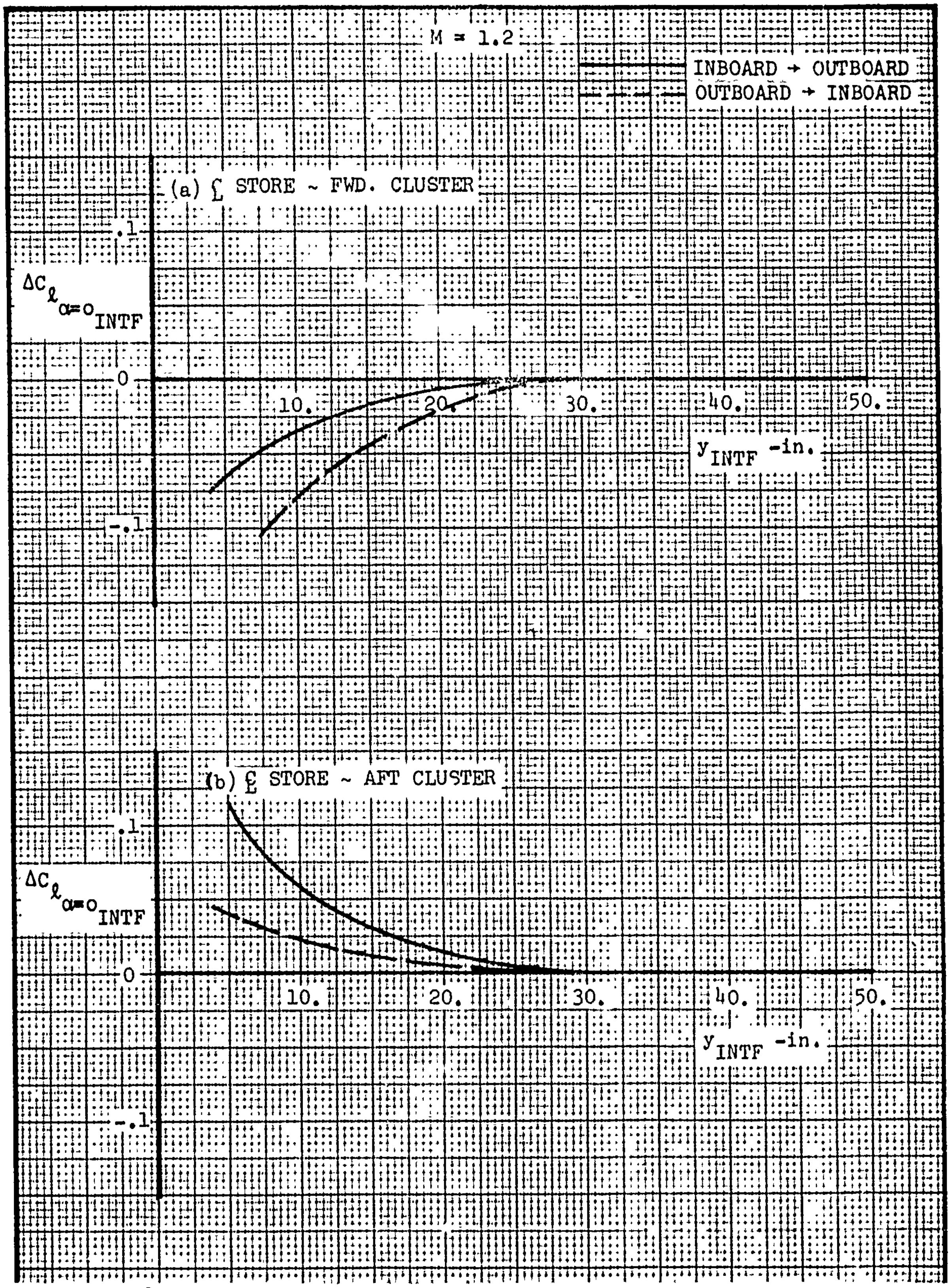


Figure 877. Incremental Rolling Moment Intercept Due to Interference - Centerline Store at M=1.2

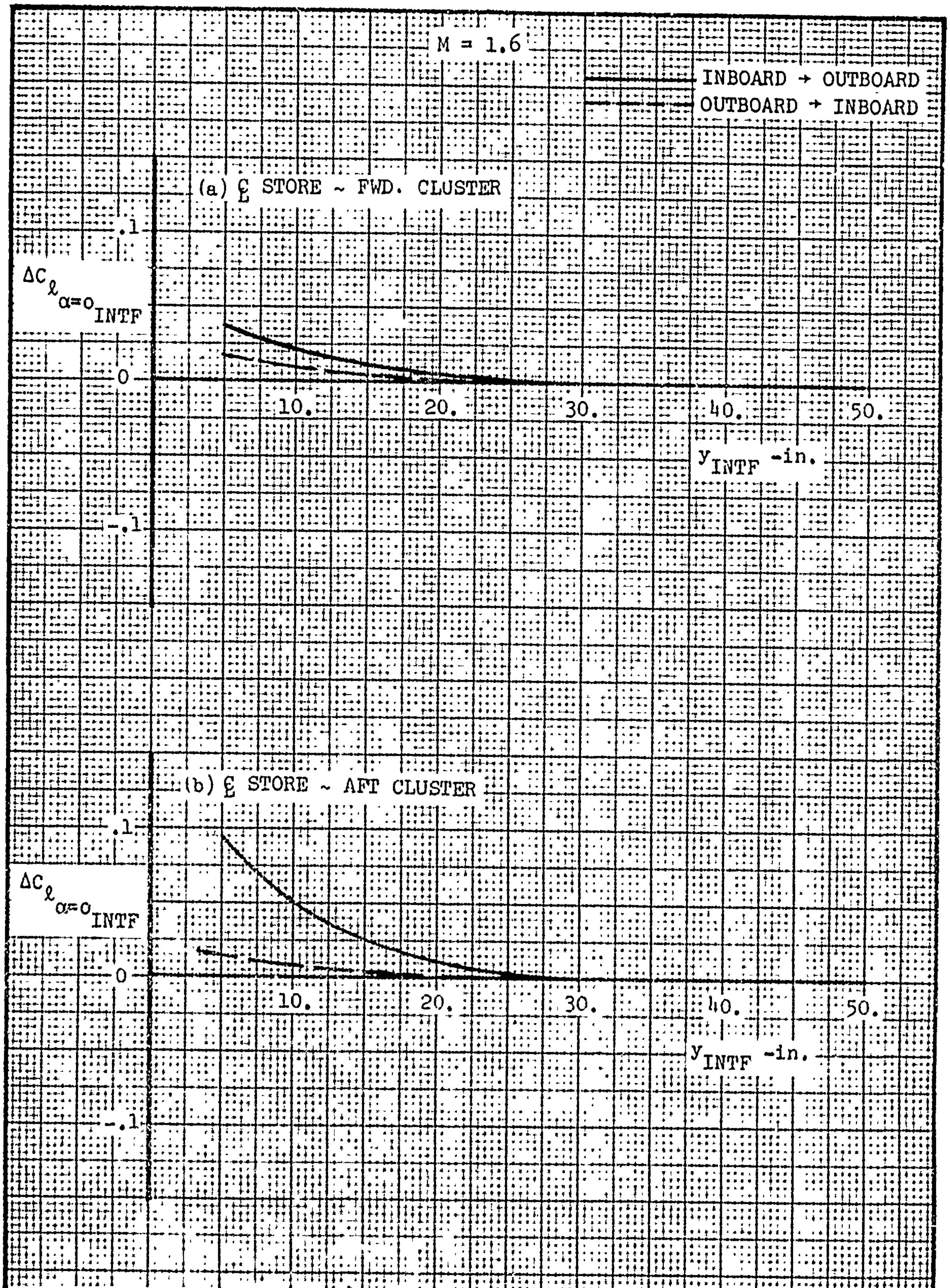


Figure 878. Incremental Rolling Moment Intercept Due to Interference - Centerline Store at M=1.6

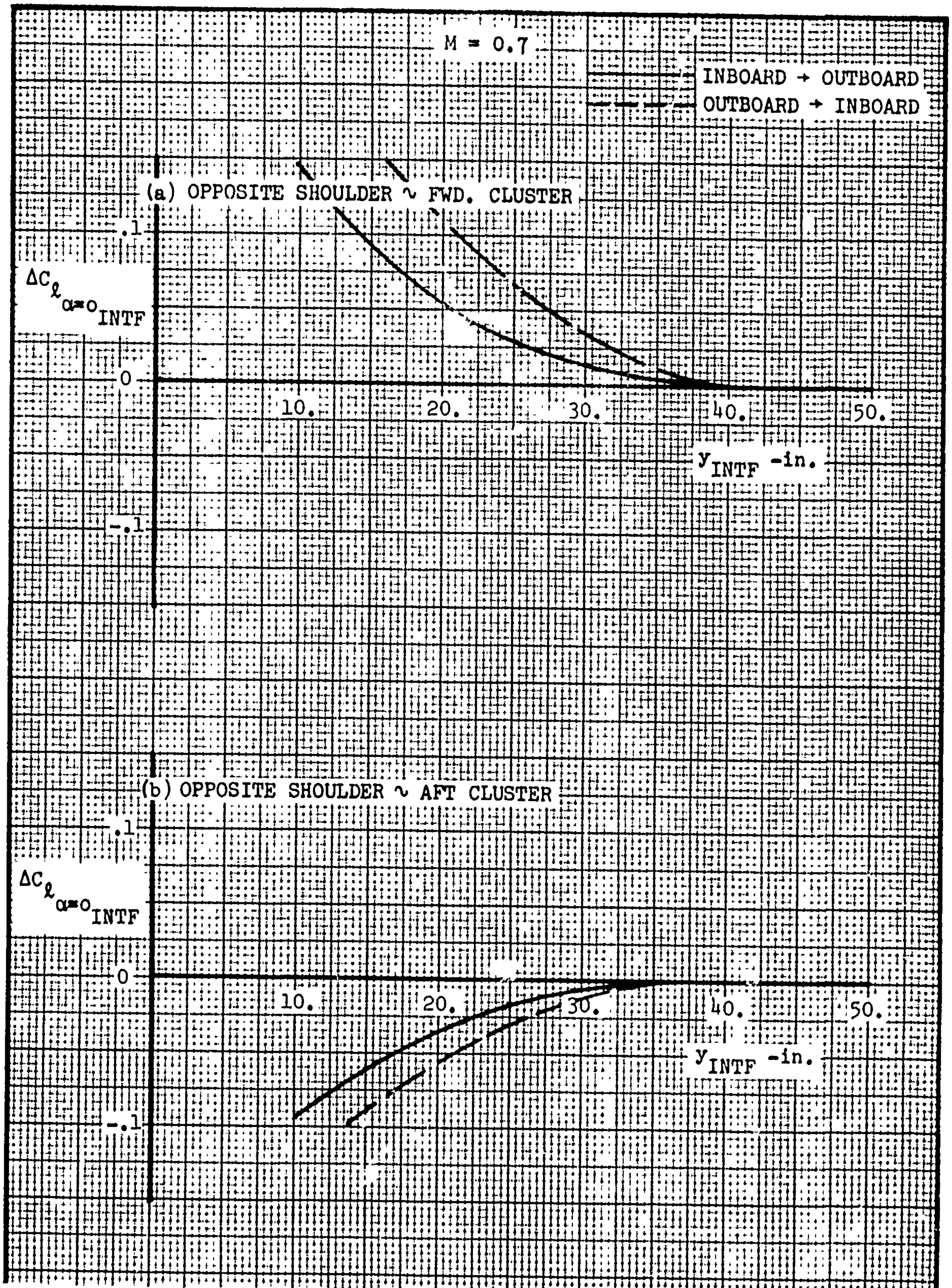


Figure 879. Incremental Rolling Moment Intercept Due to Interference - Opposite Shoulder at M=0.7

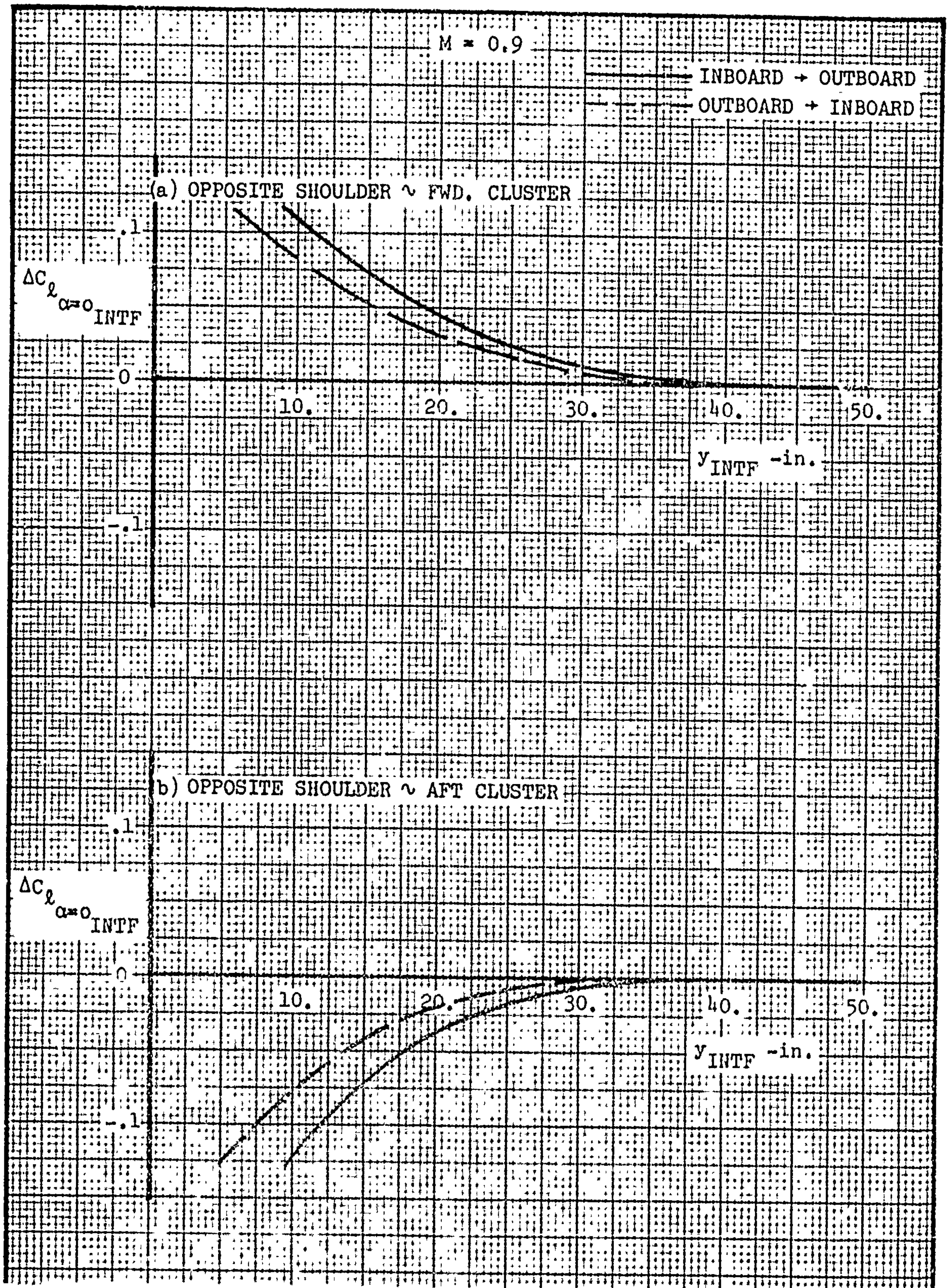


Figure 860. Incremental Rolling Moment Intercept Due to Interference - Opposite Shoulder at M=0.9

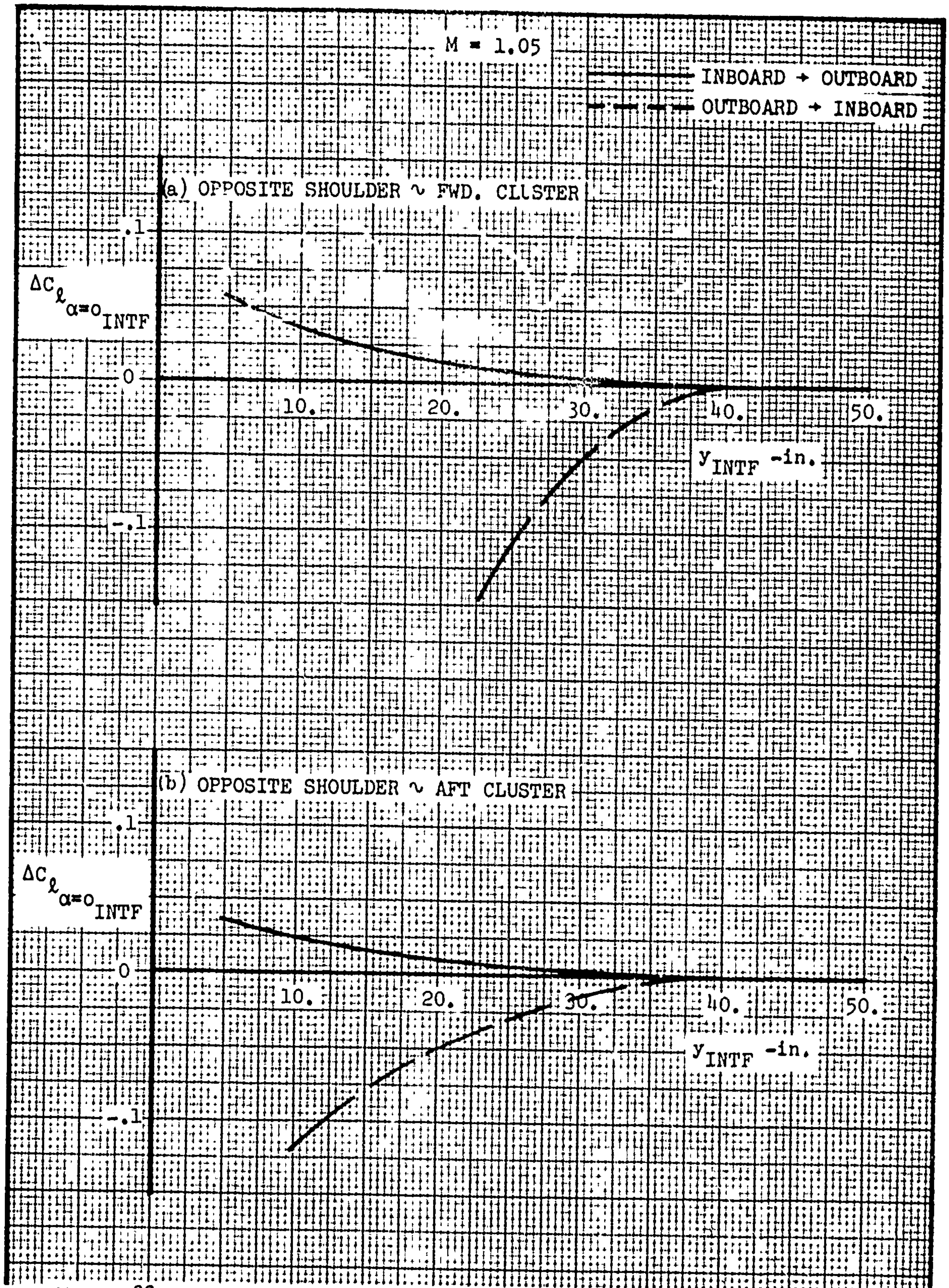


Figure 881. Incremental Rolling Moment Intercept Due to Interference - Opposite Shoulder at M=1.05

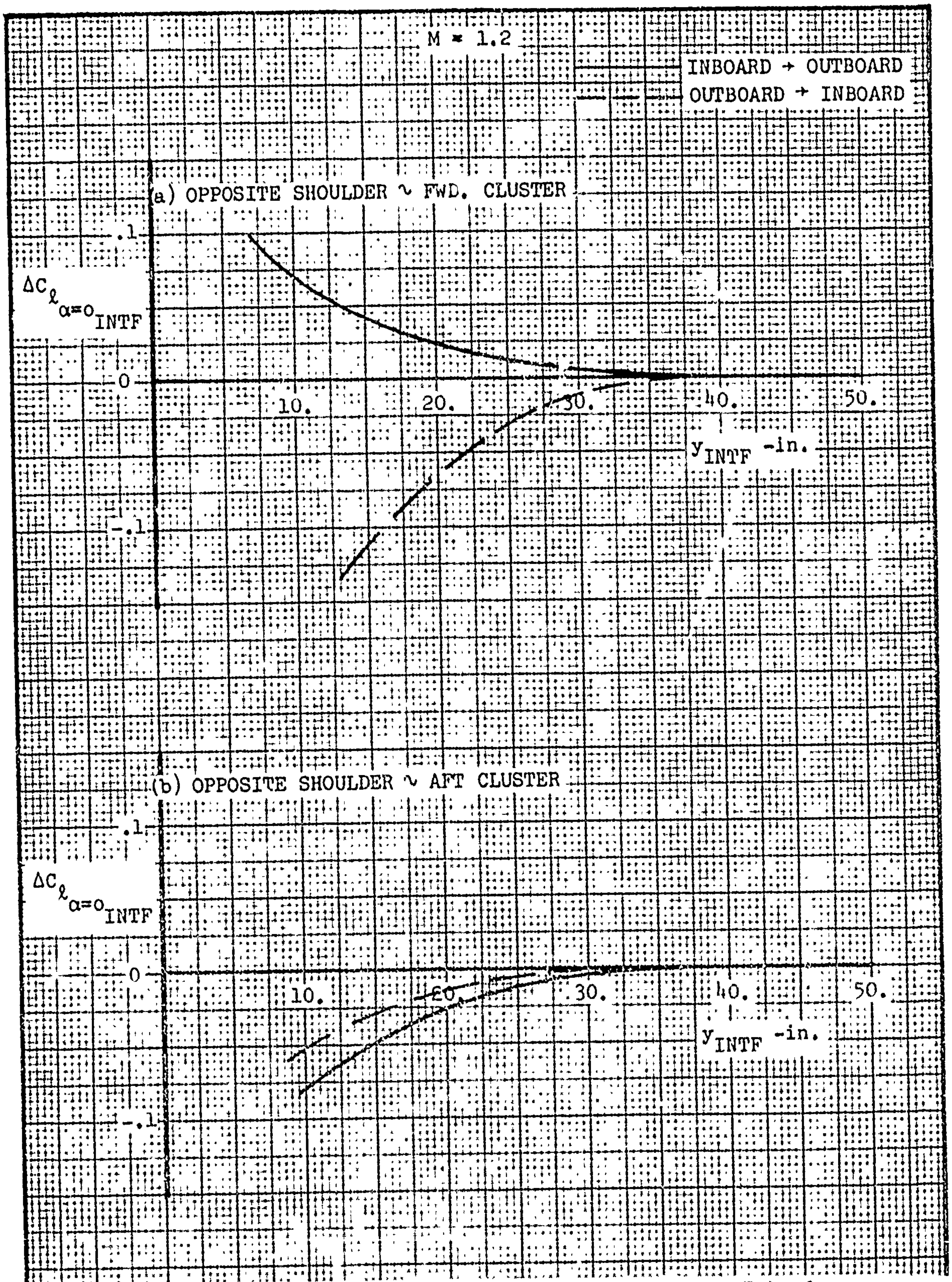


Figure 882. Incremental Rolling Moment Intercept Due to Interference - Opposite Shoulder at M=1.2

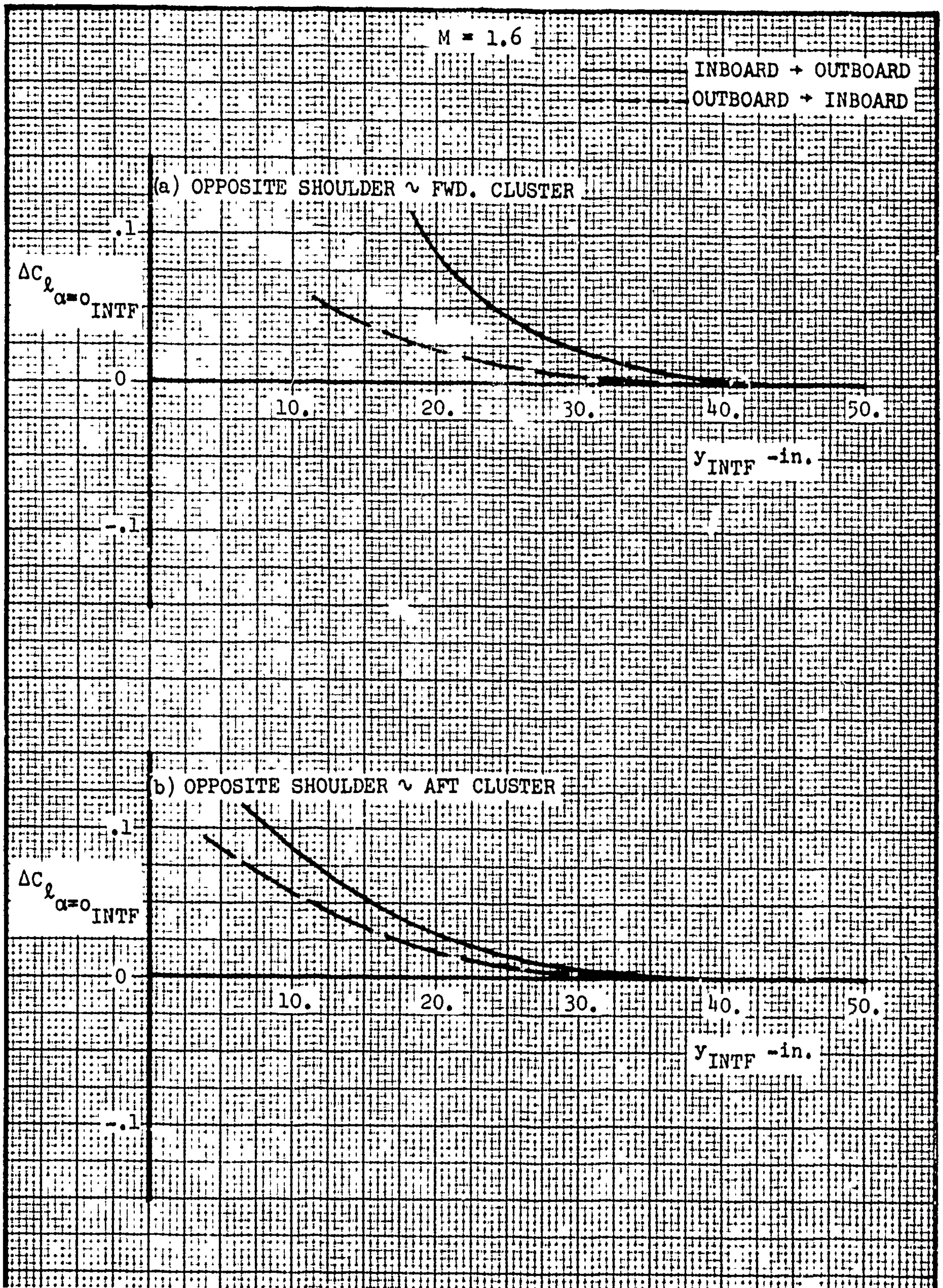


Figure 883. Incremental Rolling Moment Intercept Due to Interference - Opposite Shoulder at M=1.6

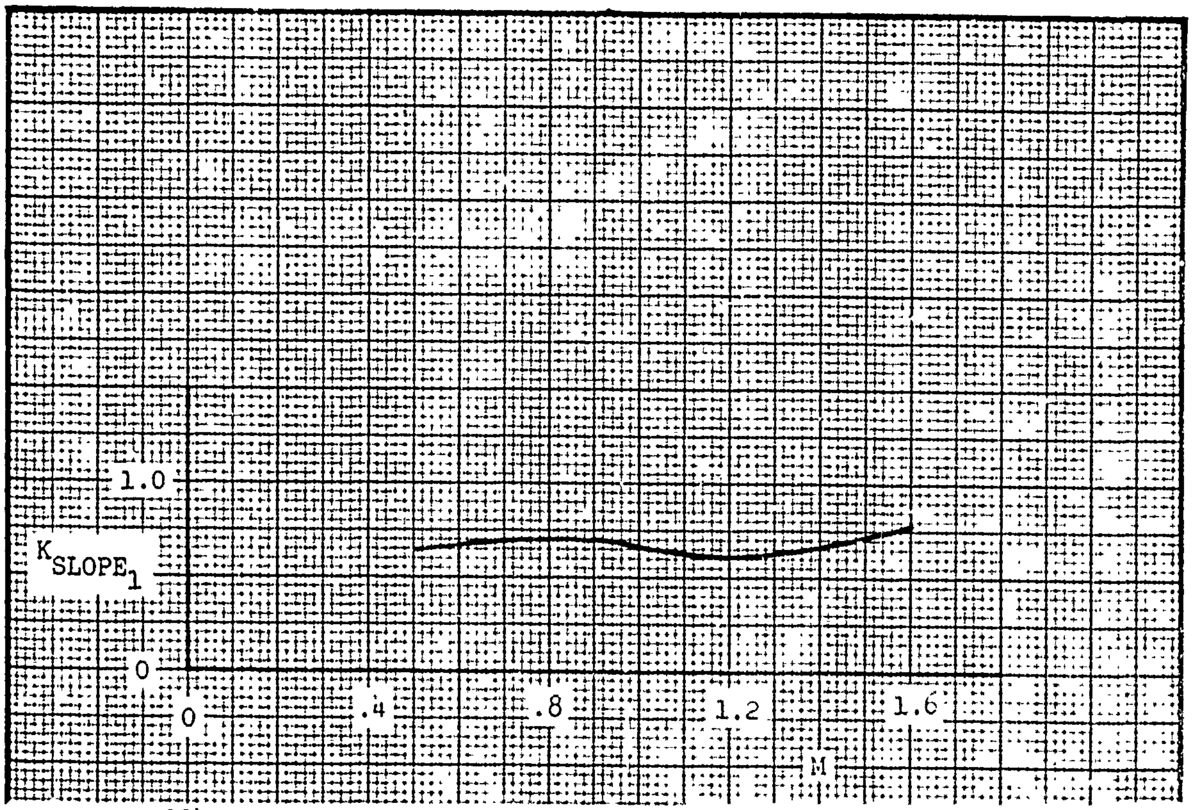


Figure 884. Incremental Rolling Moment Intercept Due to Interference - K_{SLOPE_1} for Combination Inboard and Outboard Interference

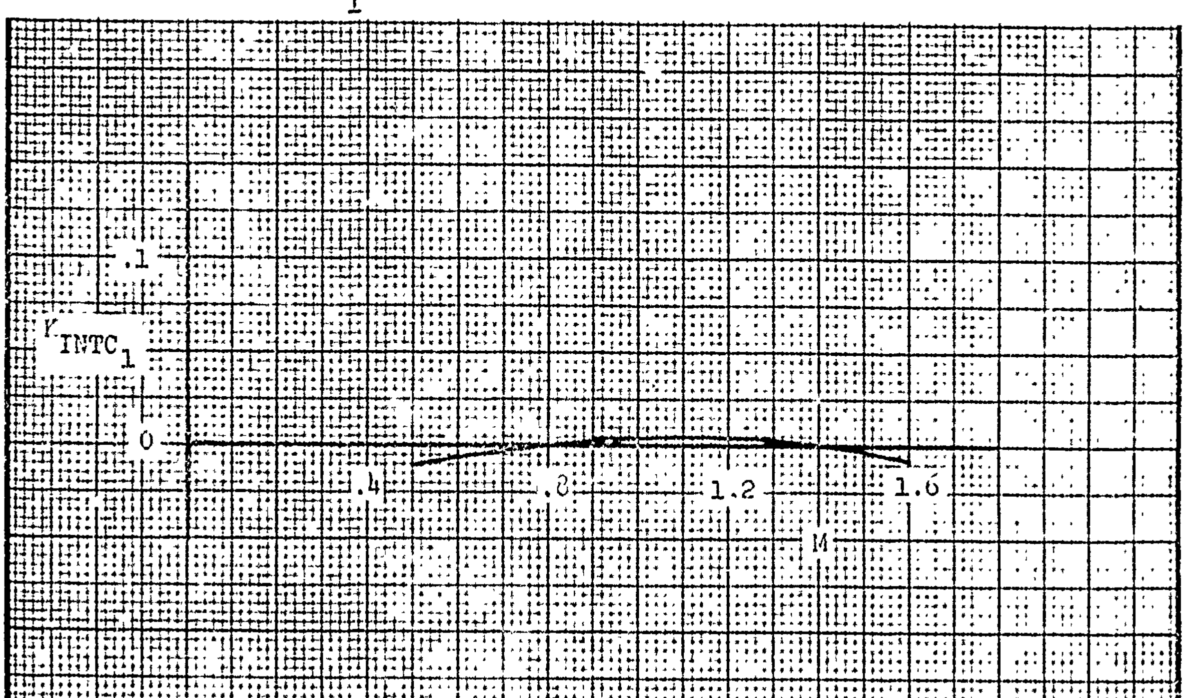


Figure 885. Incremental Rolling Moment Intercept Due to Interference - K_{INTC_1} for Combination Inboard and Outboard Interference

SECTION V

TER CARRIAGE AIRLOAD PREDICTION

The technique for predicting captive airloads for stores on a fully loaded triple ejector rack is presented in this section. The basic approach consists of performing the complete captive airload predictions for the forward clu[illegible] on a MER carried at the applicable pylon location and correcting these predictions to account for the absence of the aft cluster. An additional correction is made for each component except axial force to account for the difference in mid-lug locations between the installed TER and the forward cluster on the MER.

Sufficient data were available only for M117 stores to develop the prediction for stores carried on a TER. Therefore, as in Section III, scaling factors are defined in order to scale the predicted airloads as a function of isolated aerodynamic characteristics and physical size to apply to other store types. The scaling factors for side force and normal force are presented below.

$$K_{SCALE_{SF}} = \frac{\left(\frac{SF}{q}\right)_{\psi_{ISO}} SPA}{96} \; (ft^2)$$

where:

$\left(\frac{SF}{q}\right)_{\psi_{ISO}}$ - Store isolated characteristic, $C_{L_{\alpha_{ISO}}} \cdot S_{REF}$, where $C_{L_{\alpha_{ISO}}}$ is obtained from the method included in Reference 1, $\frac{ft^2}{deg}$

SPA - Store total side projected area as defined in Subsection 2.2, in^2

$$K_{SCALE_{NF}} = \frac{\left(\frac{NF}{q}\right)_{\alpha_{ISO}} PPA}{96} \; (ft^2)$$

where:

$\left(\frac{NF}{q}\right)_{\alpha_{ISO}}$ - Store isolated characteristic, $C_{L_{\alpha_{ISO}}} \cdot S_{REF}$, where $C_{L_{\alpha_{ISO}}}$ is obtained from the method included in Reference 1, $\frac{ft^2}{deg}$.

PPA - Store total plan projected area as defined in Subsection 2.2, in^2

Similarly, the scaling factors for yawing moment, pitching moment, and rolling moment are presented below.

$$K_{SCALE_{YM}} = \frac{\left(\frac{SF}{q}\right)_{\psi_{ISO}} SPA}{71.4} \; (ft^3)$$

$$K_{SCALE_{PM}} = \frac{\left(\frac{NF}{q}\right)_{\alpha_{ISO}} PPA}{71.4} \; (ft^3)$$

$$K_{SCALE_{RM}} = \frac{\left(\frac{SF}{q}\right)_{\psi_{ISO}} SPA}{71.4} \; (ft^3)$$

where the terms in each of the equations are defined above.

5.1 SLOPE PREDICTION

The prediction of the varation of captive store airloads with angle of attack for stores carried on a TER is divided into three sections according to the airload component.

1. Side force, yawing moment, and rolling moment.
2. Normal force and pitching moment.
3. Axial force.

Each of these is presented below.

SIDE FORCE, YAWING MOMENT, AND ROLLING MOMENT

TER STATION 1 (TS1):

AT A GIVEN MACH NUMBER

$$\left(\frac{z}{q}\right)_{\alpha_{TS1}} = \left(\frac{z}{q}\right)_{\alpha_{MS2}} - \left[\Delta C_{x_{\alpha_{TS1}}} - K_{ML_{LAT}} \bullet \Delta^2 C_{x_{\alpha_{TS1}}}\right] K_{SCALE_z}$$

and

$$\Delta C_{x_{\alpha_{TS1}}} = K_{\Lambda_1} \Delta C_{x_{\alpha_{SIDEWASH}}}$$

Where x = y, η, or ℓ and z = SF, YM, or RM yielding the equation applicable to side force, yawing moment, or rolling moment, respectively.

and

$\left(\frac{z}{q}\right)_{\alpha_{MS2}}$ - Prediction of the subject airload for a store carried on MER Station 2, where the mid-lug point of the MER is at the carriage location of the mid-lug point for the TER, see Section IV.

$\Delta C_{x_{\alpha_{SIDEWASH}}}$ - Incremental airload based on the sidewash variation due to the absence of the aft cluster of stores on a MER. For fuselage-mounted stores let $\Delta C_{x_{\alpha_{SIDEWASH}}} = 0$

SIDE FORCE - Figure 888

YAWING MOMENT - Figure 889

ROLLING MOMENT - Figure 890

K_{Λ_1} - Aircraft wing sweep correction factor based on the sweep angle, Λ, of the quarter-chord, $\frac{\sin \Lambda}{\sin 45°}$.

$K_{ML_{LAT}}$ - Correction factor to account for the chordwise variation of the mid-lug point of the TER, Figure 896. For fuselage-mounted stores let $K_{ML_{LAT}} = 0$.

$\Delta^2 C_{x_\alpha}$ - Increment due to chordwise variation between the mid-lug points for the forward cluster on a MER and the TER.

SIDE FORCE - Figure 893

YAWING MOMENT - Figure 894

ROLLING MOMENT - Figure 895

K_{SCALE_z} - Appropriate scale factor, see Section V.

TER STATIONS 2 and 3 (TS2,3):

AT A GIVEN MACH NUMBER

$$\left(\frac{z}{q}\right)_{\alpha_{TS2,3}} = \left(\frac{z}{q}\right)_{\alpha_{MS4,6}} - [\Delta C_{x_{\alpha_{TS2,3}}} - K_{ML_{LAT}} \cdot \Delta^2 C_{x_{\alpha_{TS2,3}}}] K_{SCALE_z}$$

and

$$\Delta C_{x_{\alpha_{TS2,3}}} = K_{\Lambda_1} \Delta C_{x_{\alpha_{SIDEWASH}}} + \Delta C_{x_{\alpha_{SHOULDER}}}$$

Where $x = y$, η, or ℓ and z = SF, YM, or RM yielding the equation applicable to side force, yawing moment, or rolling moment, respectively.

and

$\left(\frac{z}{q}\right)_{\alpha_{MS4,6}}$ - Defined above for MER Station 2. MER Station 4 should be used when predicting airloads at TS2 and MER Station 6 should be used when predicting airloads at TS3, see Section IV.

$\Delta C_{x_{\alpha_{SIDEWASH}}}$ - Defined above.

K_{Λ_1} - Defined above.

$\Delta C_{x_{\alpha_{SHOULDER}}}$ - Incremental airload for the shoulder stores due to the absence of the aft cluster of stores on a MER.

SIDE FORCE - Figure 888

YAWING MOMENT - Figure 889

ROLLING MOMENT - Figure 890

$K_{ML_{LAT}}$ - Defined above.

$\Delta^2 C_{x_\alpha}$ - Defined above.

K_{SCALE_z} - Appropriate scale factor, see Section V.

<u>NORMAL FORCE AND PITCHING MOMENT</u>

TER STATION 1,2, and 3 (TS1,2,3):

AT A GIVEN MACH NUMBER

$$\left(\frac{z}{q}\right)_{\alpha_{TS1,2,3}} = \left(\frac{z}{q}\right)_{\alpha_{MS2,4,6}} - [\Delta C_{x_{\alpha_{TS1,2,3}}} - K_{ML_{LONG}} \cdot \Delta^2 C_{x_{\alpha_{TS1,2,3}}}] K_{SCALE_z}$$

Where x = N or m and z = NF or PM yielding the equation applicable to normal force or pitching moment, respectively.
and

$\left(\frac{z}{q}\right)_{\alpha_{MS2,4,6}}$ - Prediction of the subject airload for a store carried on MER Station 2,4, or 6, where the mid-lug point of the MER is at the carriage location of the mid-lug point for the TER, see Section IV. The following MER stations correspond to the subject TER stations.
MER STATION 2 - TER STATION 1
MER STATION 4 - TER STATION 2
MER STATION 6 - TER STATION 3

ΔC_{x_α} - Incremental airload due to the absence of the aft cluster of stores on a MER.
NORMAL FORCE - Figure 886
PITCHING MOMENT - Figure 887

$K_{ML_{LONG}}$ - Correction factor to account for the chordwise variation of the mid-lug point for the TER, Figure [illegible]. For fuselage-mounted stores let $K_{ML_{LONG}} = 0$.

$\Delta^2 C_{x_\alpha}$ - Increment due to chordwise variation between the mid-lug points for the forward cluster on a MER and the TER.
NORMAL FORCE - Figure 891
PITCHING MOMENT - Figure 892

K_{SCALE_z} - Appropriate scale factor, see Section V.

AXIAL FORCE

TER STATIONS 1,2, and 3 (TS1,2,3):

AT A GIVEN MACH NUMBER

$$\left(\frac{AF}{q}\right)_{\alpha_{TS1,2,3}} = K_{TER_1}\left(\frac{AF}{q}\right)_{\alpha_{MS2,4,6}}$$

where:

$\left(\frac{AF}{q}\right)_{\alpha_{MS2,4,6}}$ - Prediction of the subject airload for a store carried on MER Station 2,4, or 6, see

Subsection 4.5. The following MER Stations correspond to the subject TER Stations.

MER STATION 2 - TER STATION 1

MER STATION 4 - TER STATION 2

MER STATION 6 - TER STATION 3

K_{TER_1} - Correction factor for axial force slope due to the absence of the aft cluster of stores on a MER, Figure 898.

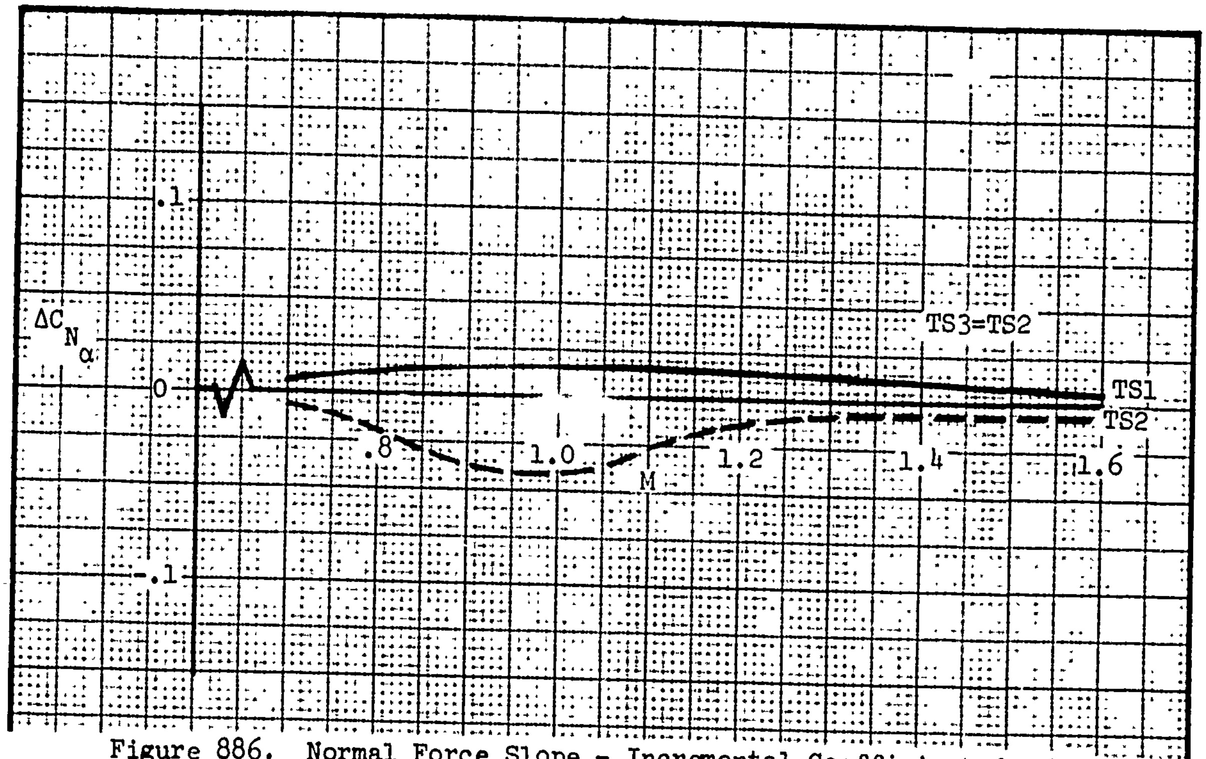


Figure 886. Normal Force Slope - Incremental Coefficient for TER Carriage

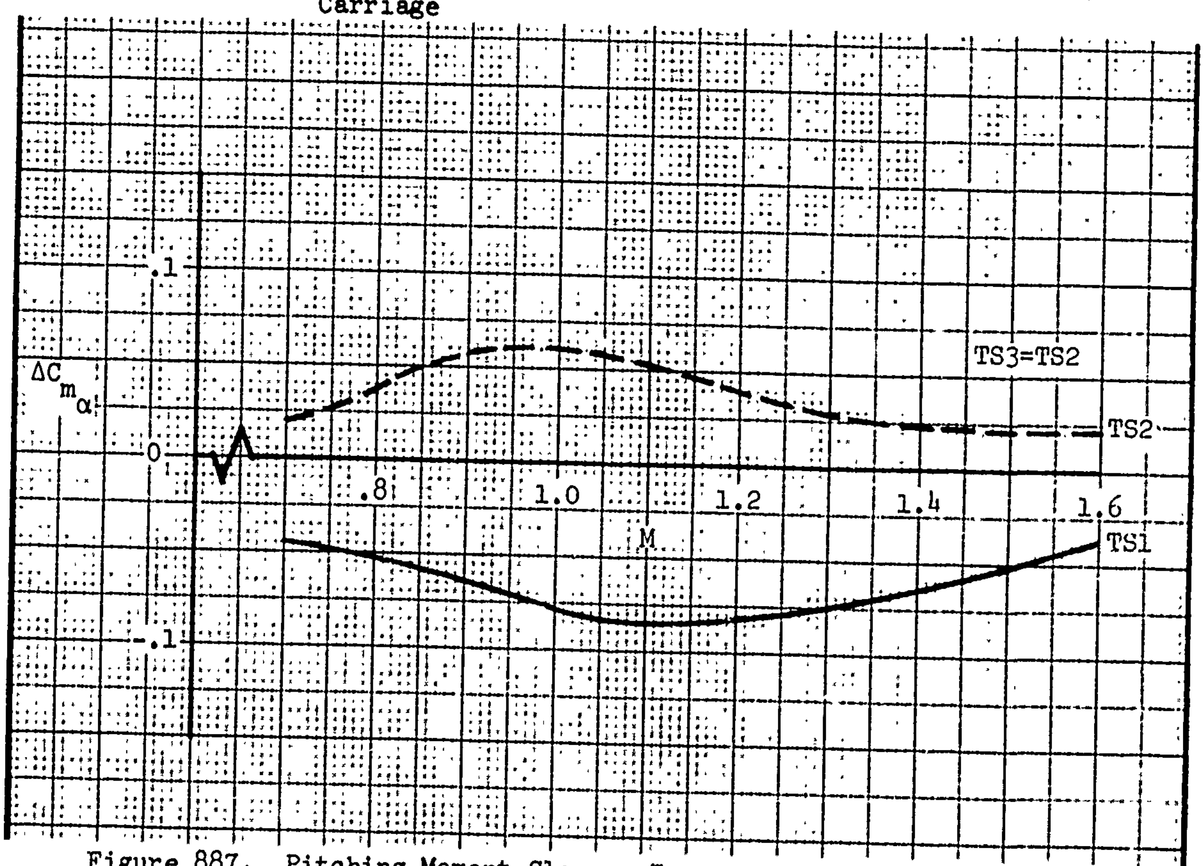


Figure 887. Pitching Moment Slope - Incremental Coefficient for TER Carriage

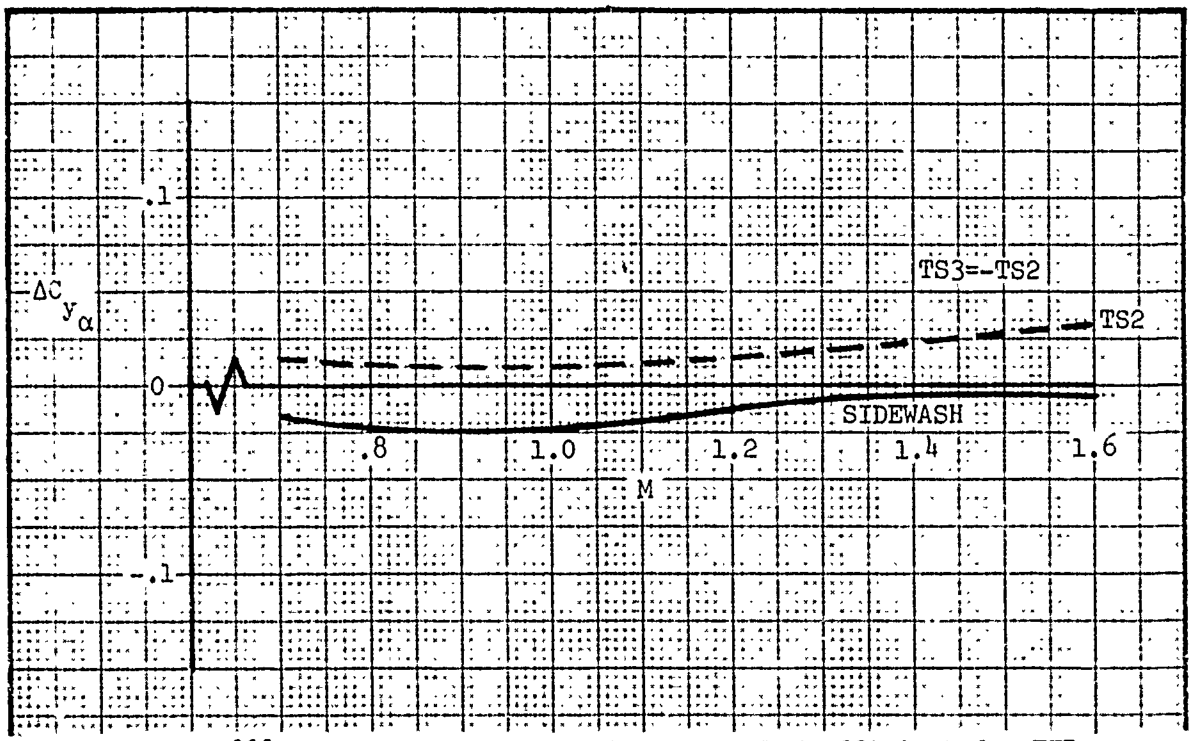


Figure 888. Side Force Slope - Incremental Coefficient for TER Carriage

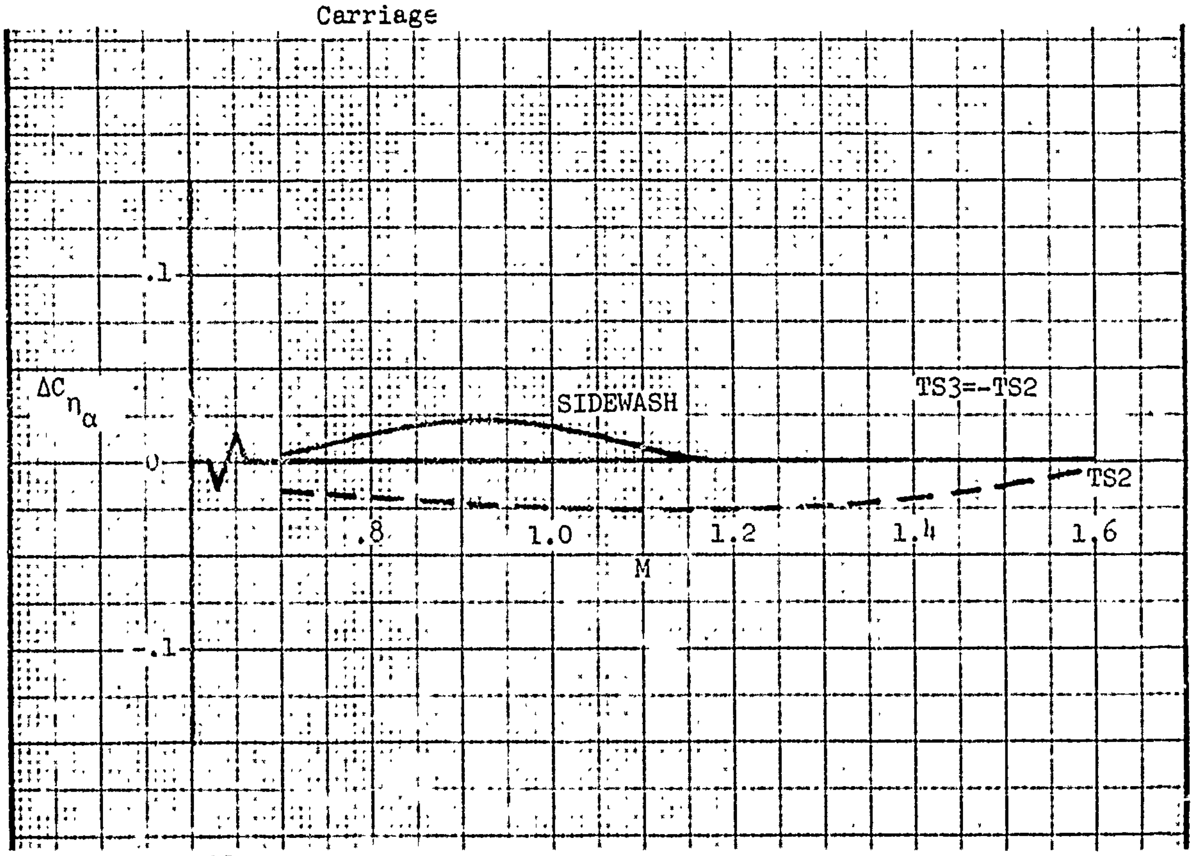


Figure 889. Yawing Moment Slope - Incremental Coefficient for TER Carriage

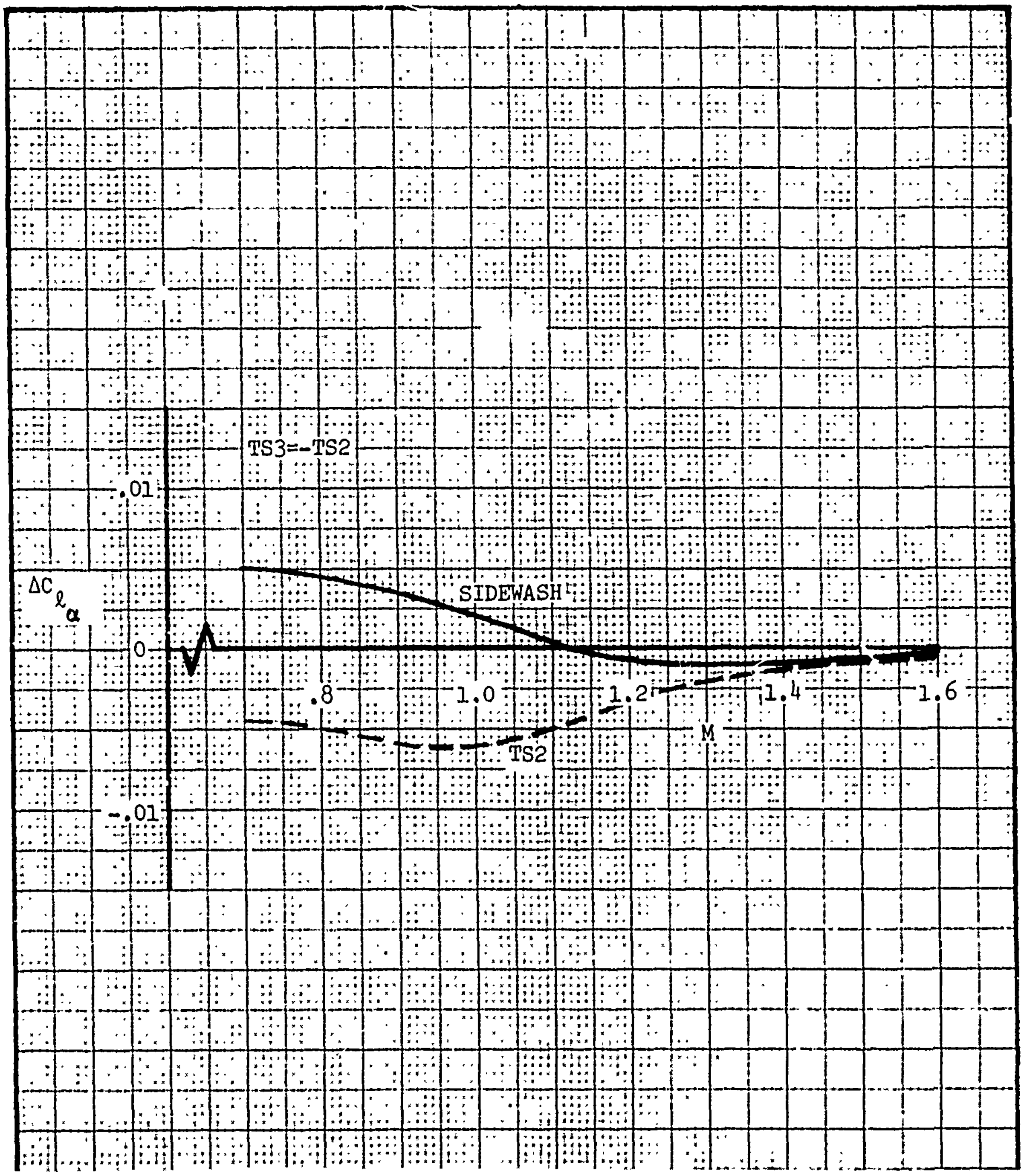


Figure 890. Rolling Moment Slope - Incremental Coefficient for TER Carriage

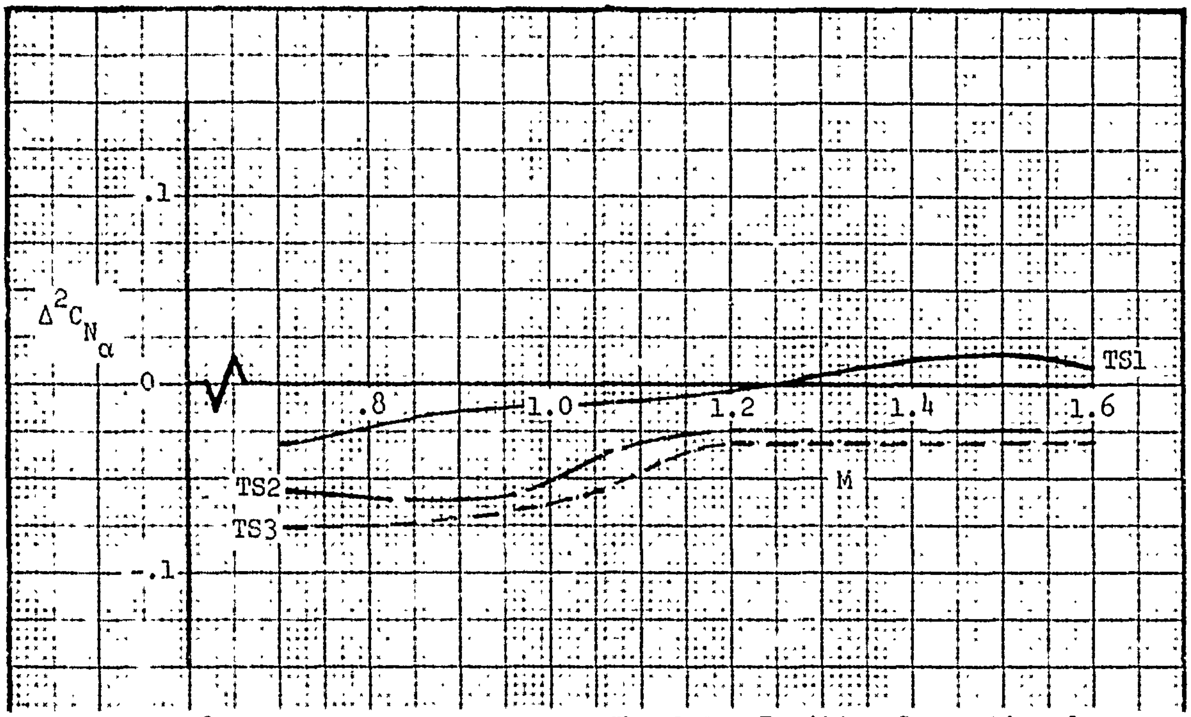


Figure 891. Normal Force Slope - Chordwise Position Correction for TER Carriage

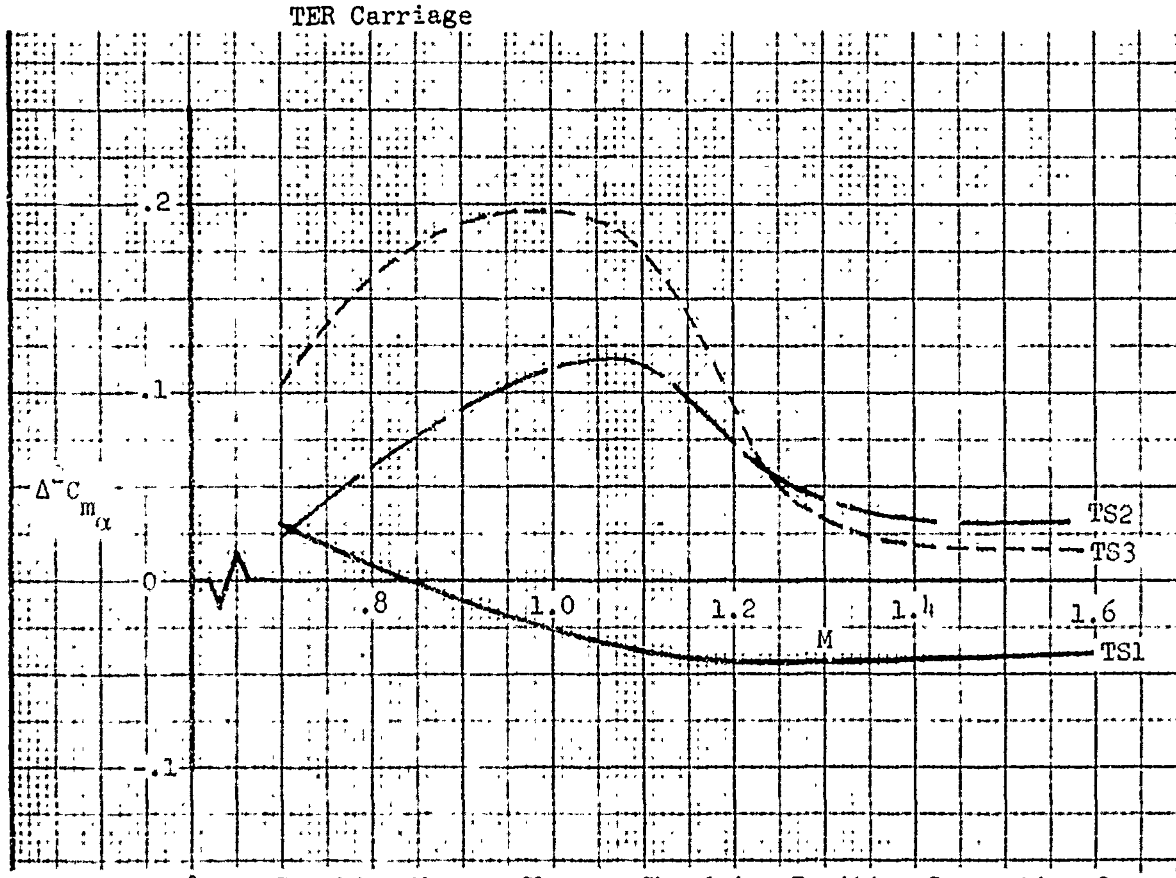


Figure 892. Pitching Moment Slope - Chordwise Position Correction for TER Carriage

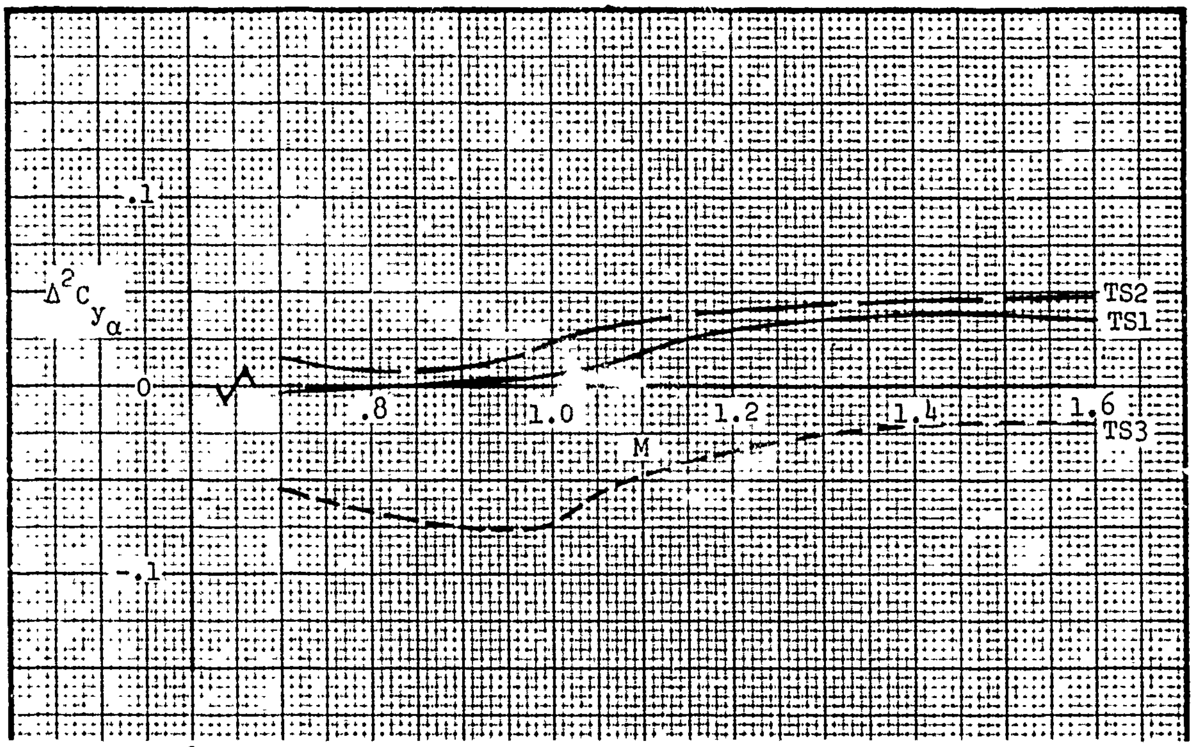


Figure 893. Side Force Slope - Chordwise Position Correction for TER Carriage

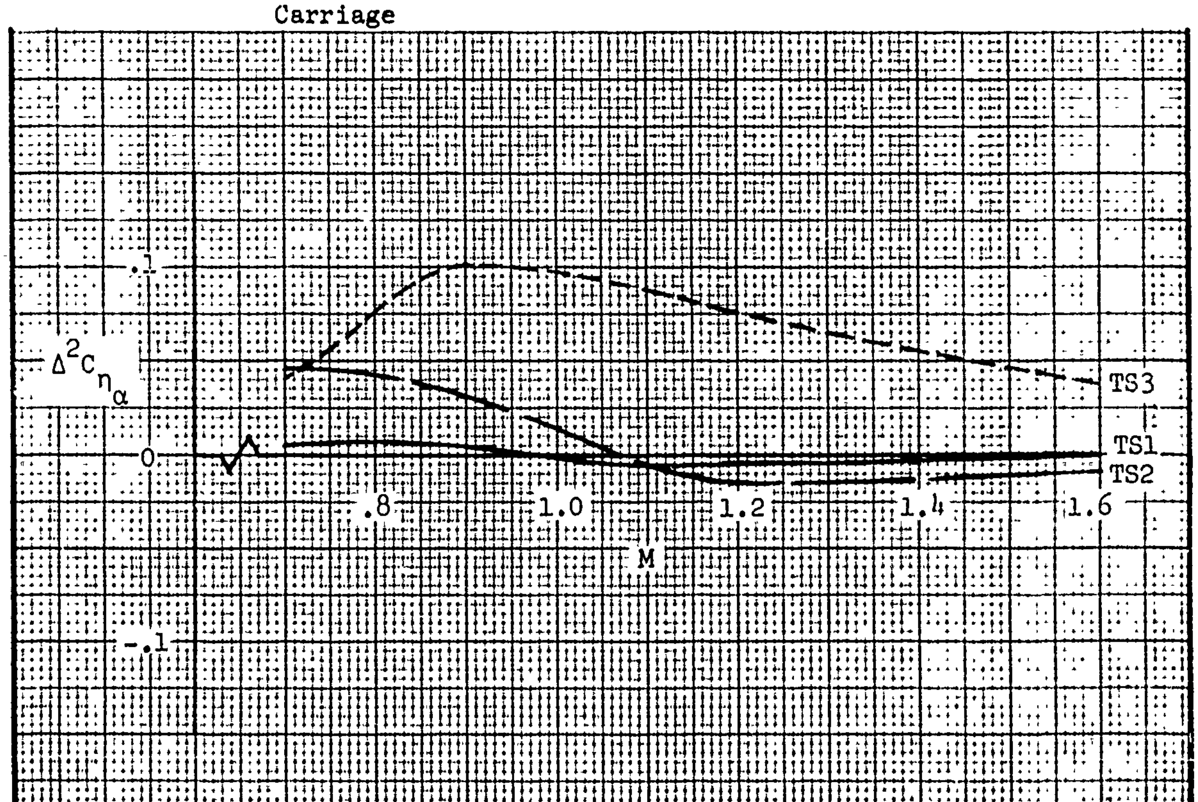


Figure 894. Yawing Moment Slope - Chordwise Position Correction for TER Carriage

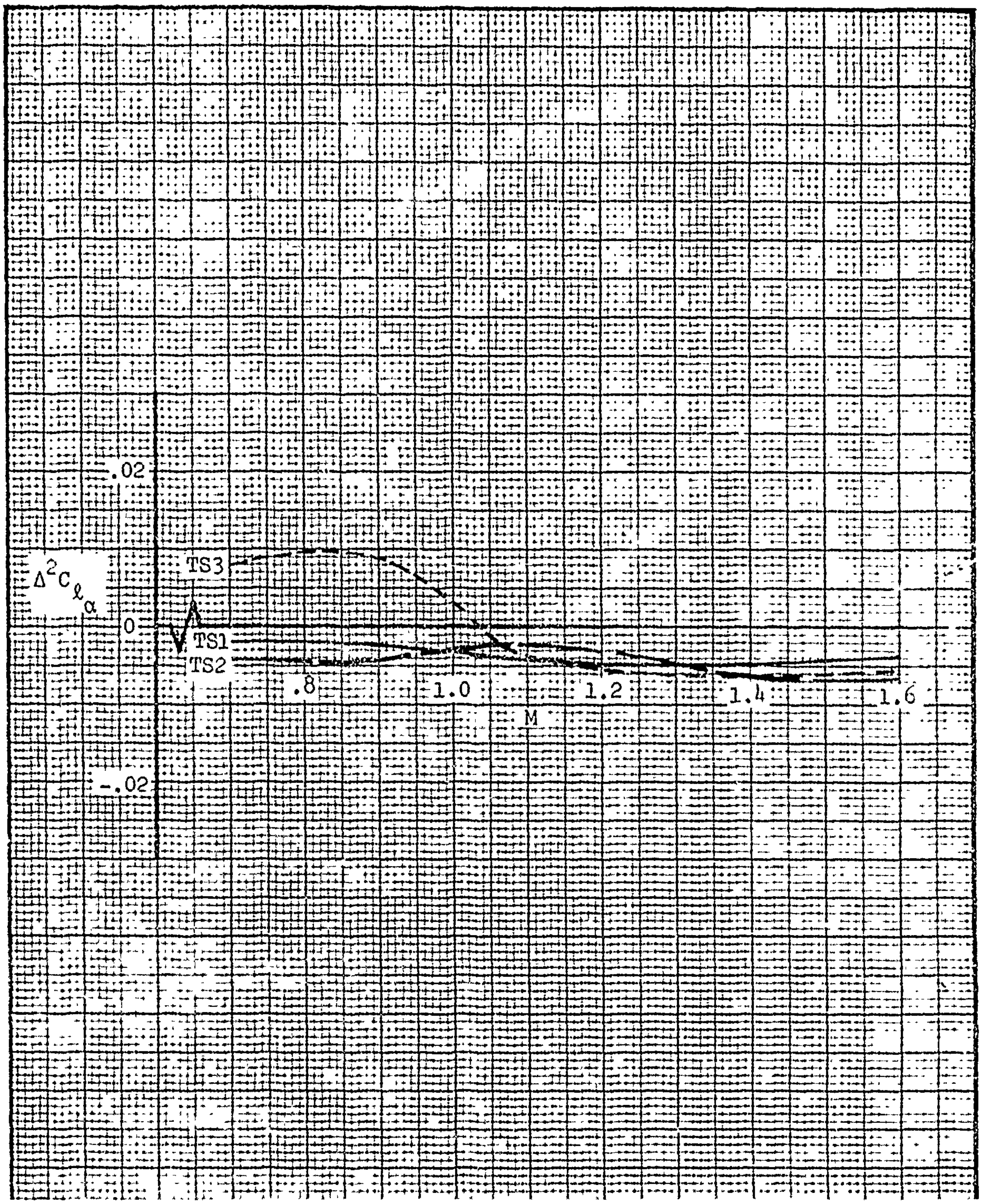


Figure 895. Rolling Moment Slope - Chordwise Position Correction for TER Carriage

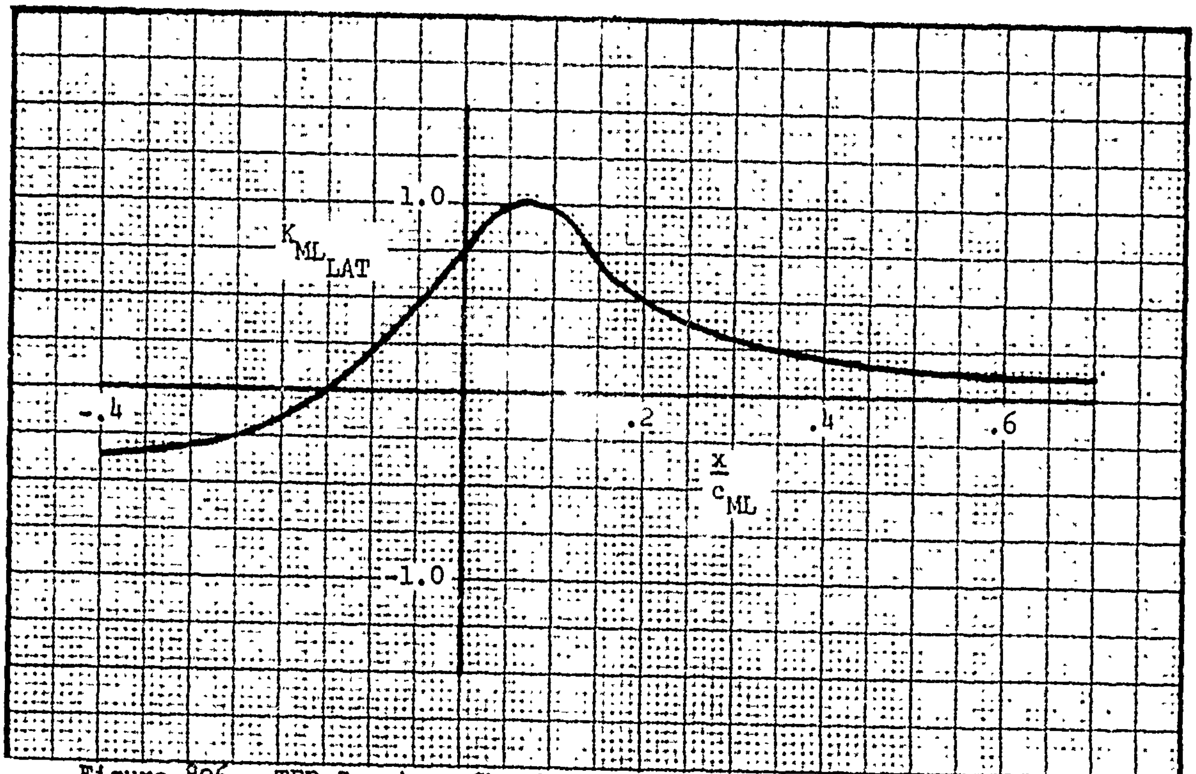


Figure 896. TER Carriage Chordwise Position Correction Factor for Side Force, Yawing Moment, and Rolling Moment

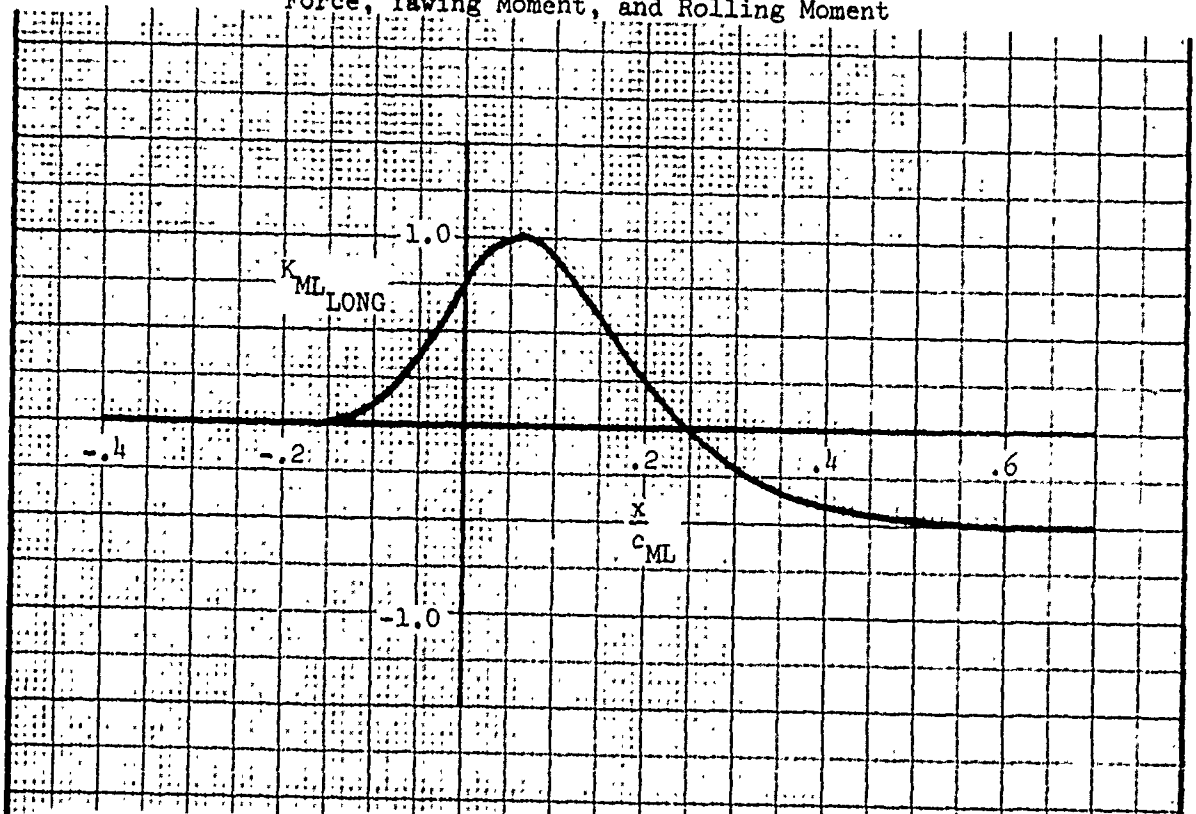


Figure 897. TER Carriage Chordwise Position Correction Factor for Normal Force and Pitching Moment

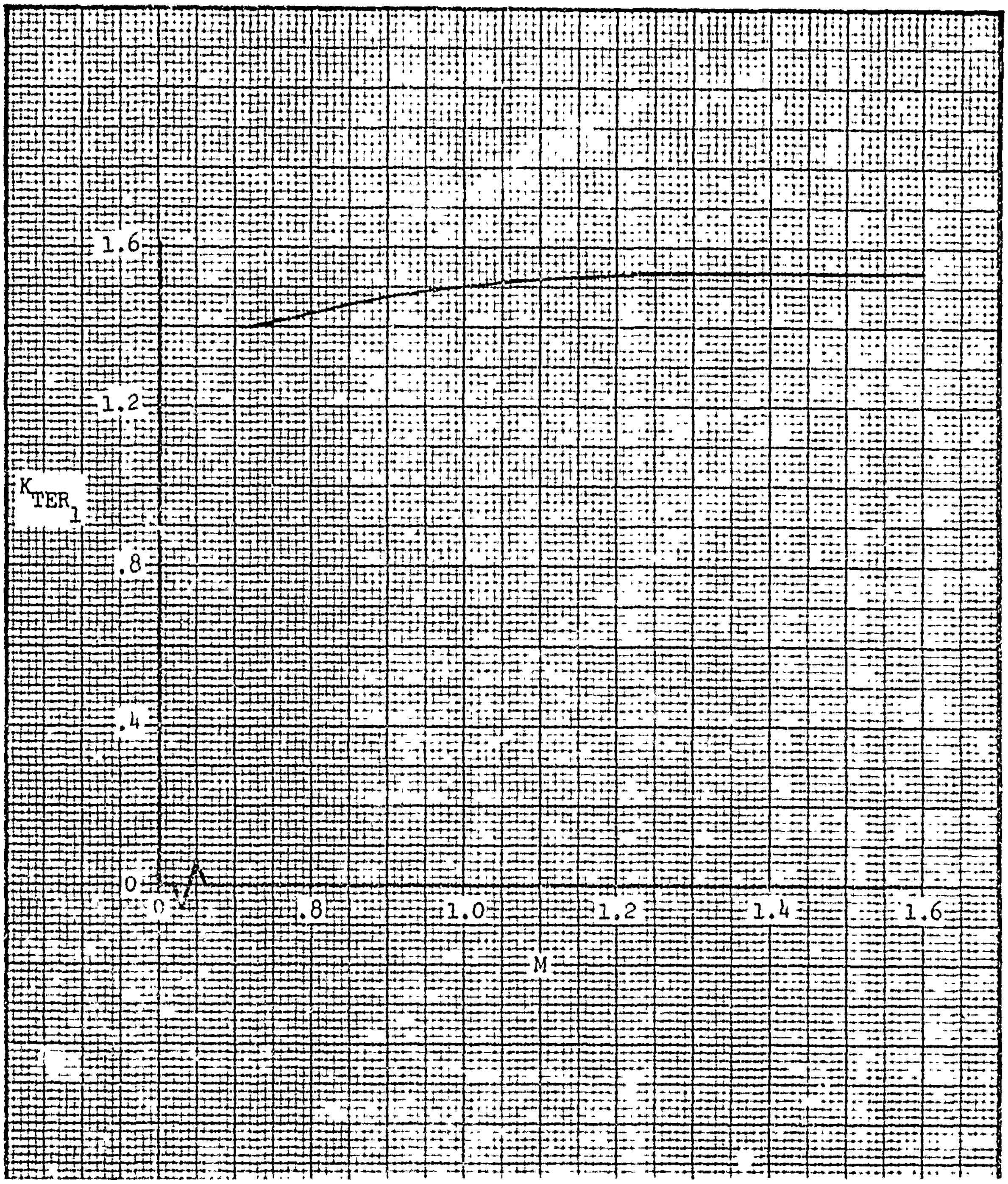


Figure 89B. Axial Force Slope Correction for TER Carriage

5.2 INTERCEPT PREDICTION

The prediction of captive store airloads at $\alpha=0$ for stores carried on a TER is divided into three sections according to the airload component.

1. Side force, yawing moment, and rolling moment.
2. Normal force and pitching moment.
3. Axial force.

Each of these is presented below.

SIDE FORCE, YAWING MOMENT, AND ROLLING MOMENT

TER STATION 1 (TS1):

AT A GIVEN MACH NUMBER

$$\left(\frac{z}{q}\right)_{\substack{\alpha=0\\ TS1}} = \left(\frac{z}{q}\right)_{\substack{\alpha=0\\ MS2}} - \left[\Delta C_{x_{\substack{\alpha=0\\ TS1}}} - K_{ME_{LAT}} \bullet \Delta^2 C_{x_{\substack{\alpha=0\\ TS1}}}\right] K_{SCALE_z}$$

and

$$\Delta C_{x_{\substack{\alpha=0\\ TS1}}} = K_{\Lambda_1} \bullet \Delta C_{x_{\substack{\alpha=0\\ SIDEWASH}}}$$

Where $x = y$, η, or ℓ and z = SF, YM, or RM yielding the equation applicable to side force, yawing moment, or rolling moment, respectively.

and

$\left(\frac{z}{q}\right)_{\substack{\alpha=0\\ MS2}}$ - Prediction of the subject airload for a store carried on MER Station 2, where the mid-lug point of the MER is at the carriage location of the mid-lug point for the TER, see Section IV.

$\Delta C_{x_{\alpha=0}}$ SIDEWASH - Incremental airload based on the sidewash variation due to the absence of the aft cluster of stores on a MER. For fuselage-mounted stores let $\Delta C_{x_{\alpha=0}}$ SIDEWASH $=0$.

SIDE FORCE - Figure 901

YAWING MOMENT - Figure 902

ROLLING MOMENT - Figure 903

K_{Λ_1} - Aircraft wing sweep correction factor based on the sweep angle, Λ, of the quarter-chord, $\frac{\sin \Lambda}{\sin 45^\circ}$.

$K_{ML_{LAT}}$ - Correction factor to account for the chordwise variation of the mid-lug point for the TER, Figure 896. For fuselage-mounted stores let $K_{ML_{LAT}} = 0$.

$\Delta^2 C_{x_{\alpha=0}}$ - Increment due to chordwise variation between the mid-lug points for the forward cluster on a MER and the TER.

SIDE FORCE - Figure 906

YAWING MOMENT - Figure 907

ROLLING MOMENT - Figure 908

K_{SCALE_z} - Appropriate scale factor, see Section V.

TER STATIONS 2 and 3 (TS2,3):

AT A GIVEN MACH NUMBER

$$\left(\frac{z}{q}\right)_{\substack{\alpha=0\\ TS2,3}} = \left(\frac{z}{q}\right)_{\substack{\alpha=0\\ MS4,6}} - \left[\Delta C_{x_{\substack{\alpha=0\\ TS2,3}}} - K_{ML_{LAT}} \cdot \Delta^2 C_{x_{\substack{\alpha=0\\ TS2,3}}}\right] K_{SCALE_z}$$

and

$$\Delta C_{x_{\alpha_{TS2,3}}} = K_{\Lambda_1} \cdot \Delta C_{x_{\alpha_{SIDEWASH}}} + \Delta C_{x_{\substack{\alpha=0\\ SHOULDER}}}$$

Where x = y, η, or ℓ and z = SF, YM, or RM yielding the equation applicable to side force, yawing moment, or rolling moment, respectively.

and

$\left(\frac{z}{q}\right)_{\substack{\alpha=0\\ MS4,6}}$ - Defined above for MER Station 2. MER Station 4 should be used when predicting airloads at TS2 and MER Station 6 should be used when predicting airloads at TS3, see Section IV.

$\Delta C_{x_{\substack{\alpha=0\\ SIDEWASH}}}$ - Defined above.

K_{Λ_1} - Defined above.

$\Delta C_{x_{\substack{\alpha=0\\ SHOULDER}}}$ - Incremental airload for the shoulder stores due to the absence of the aft cluster of stores on a MER.

SIDE FORCE - Figure 901

YAWING MOMENT - Figure 902

ROLLING MOMENT - Figure 903

$K_{ML_{LAT}}$ - Defined above.

$\Delta^2 C_{x_{\alpha=0}}$ - Defined above.

K_{SCALE_z} - Appropriate scale factor, see Section V.

NORMAL FORCE AND PITCHING MOMENT

TER STATIONS 1,2,and 3 (TS1,2,3):

AT A GIVEN MACH NUMBER

$$\left(\frac{z}{q}\right)_{\substack{\alpha=0\\TS1,2,3}} = \left(\frac{z}{q}\right)_{\substack{\alpha=0\\MS2,4,6}} - [\Delta C_{x_{\substack{\alpha=0\\TS1,2,3}}} - K_{ML_{LONG}} \bullet \Delta^2 C_{m_{\substack{\alpha=0\\TS1,2,3}}}] K_{SCALE_z}$$

Where x = N or m and z = NF or PM yielding the equation applicable to normal force or pitching moment, respectively.

and

$\left(\frac{z}{q}\right)_{\substack{\alpha=0\\MS2,4,6}}$ - Prediction of the subject airload for a store carried on MER Station 2,4,or 6, where the mid-lug point of the MER is at the carriage location of the mid-lug point for the TER, see Section IV. The following MER Stations correspond to the subject TER Station.

MER STATION 2 - TER STATION 1

MER STATION 4 - TER STATION 2

MER STATION 6 - TER STATION 3

$\Delta C_{x_{\alpha=0}}$ - Incremental airload due to the absence of the aft cluster of stores on a MER.
NORMAL FORCE - Figure 899
PITCHING MOMENT - Figure 900

$K_{ML_{LONG}}$ - Correction factor to account for the chordwise variatio· ^^ the mid-lug point for the TER, Figure 897. For fuselage-mounted stores let $K_{ML_{LONG}} = 0$.

$\Delta^2 C_{x_{\alpha=0}}$ - Increment due to chordwise variation between the mid-lug points for the forward cluster on a MER and the TER.
NORMAL FORCE - Figure 904
PITCHING MOMENT - Figure 905.

K_{SCALE_z} - Appropriate scale factor, see Section V.

AXIAL FORCE

TER STATIONS 1,2, and 3 (TS1,2,3):

AT A GIVEN MACH NUMBER

$$\left(\frac{AF}{q}\right)_{\substack{\alpha=0 \\ TS1,2,3}} = K_{TER_2} \left(\frac{AF}{q}\right)_{\substack{\alpha=0 \\ MS2,4,6}}$$

where:

$\left(\frac{AF}{q}\right)_{\substack{\alpha=0 \\ MS2,4,6}}$ - Prediction of the subject airload for a store carr·ed on MER Station 2 '. or 6, see

Subsection 4.5. The following MER Stations correspond to the subject TER Stations.

MER STATION 2 - TER STATION 1

MER STATION 4 - TER STATION 2

MER STATION 6 - TER STATION 3

K_{TER_2} - Correction factor for axial force intercept due to the absence of the aft cluster of stores on a MER, Figure 909.

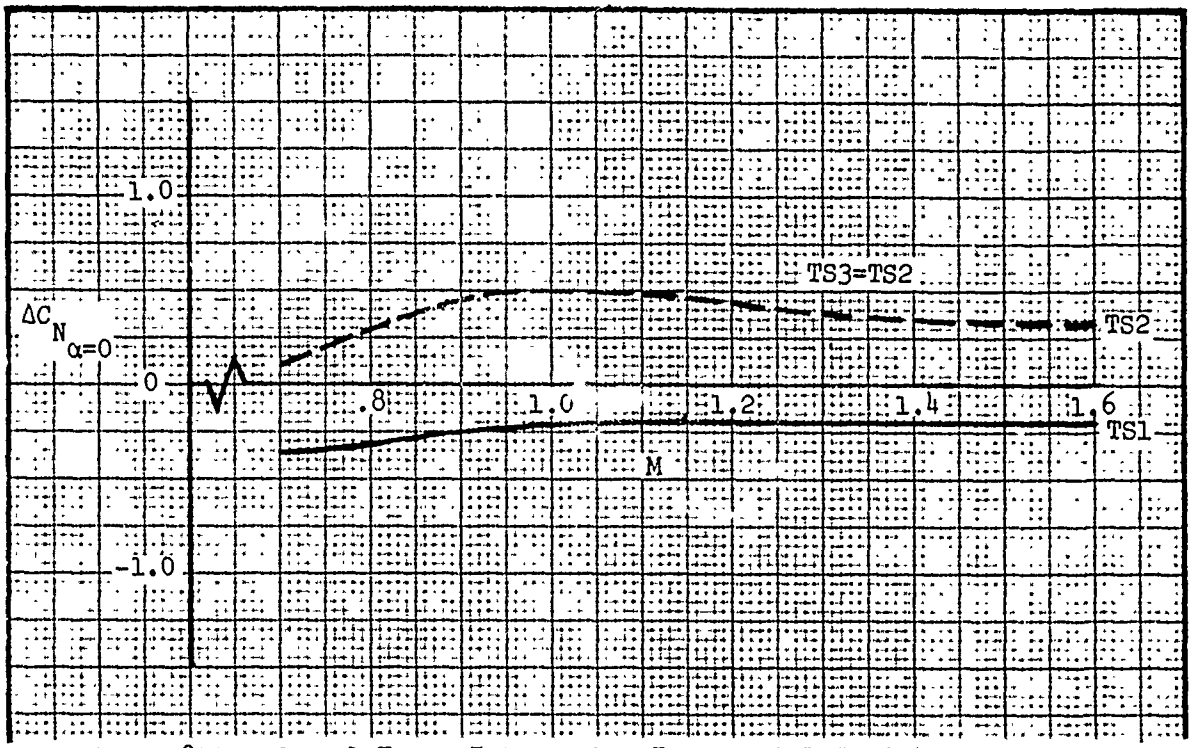


Figure 899. Normal Force Intercept - Incremental Coefficient for TER Carriage

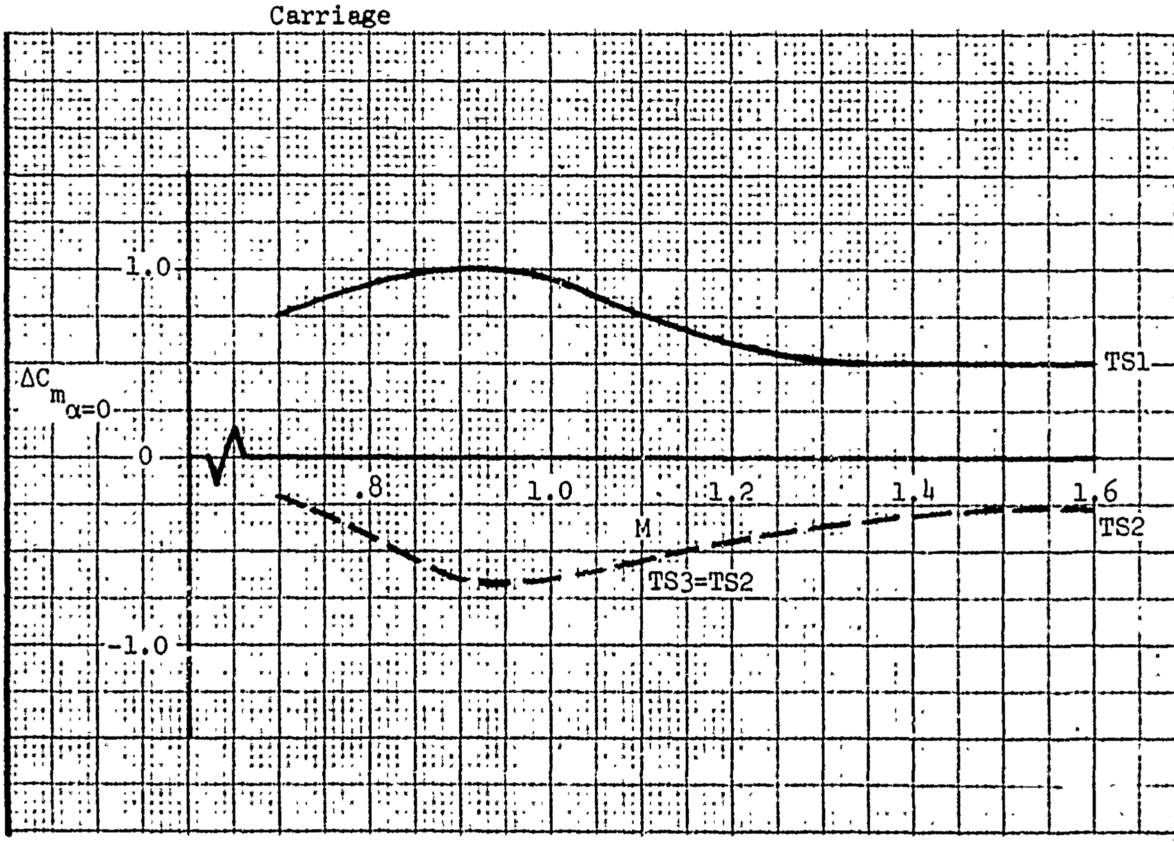


Figure 900. Pitching Moment Intercept - Incremental Coefficient for TER Carriage

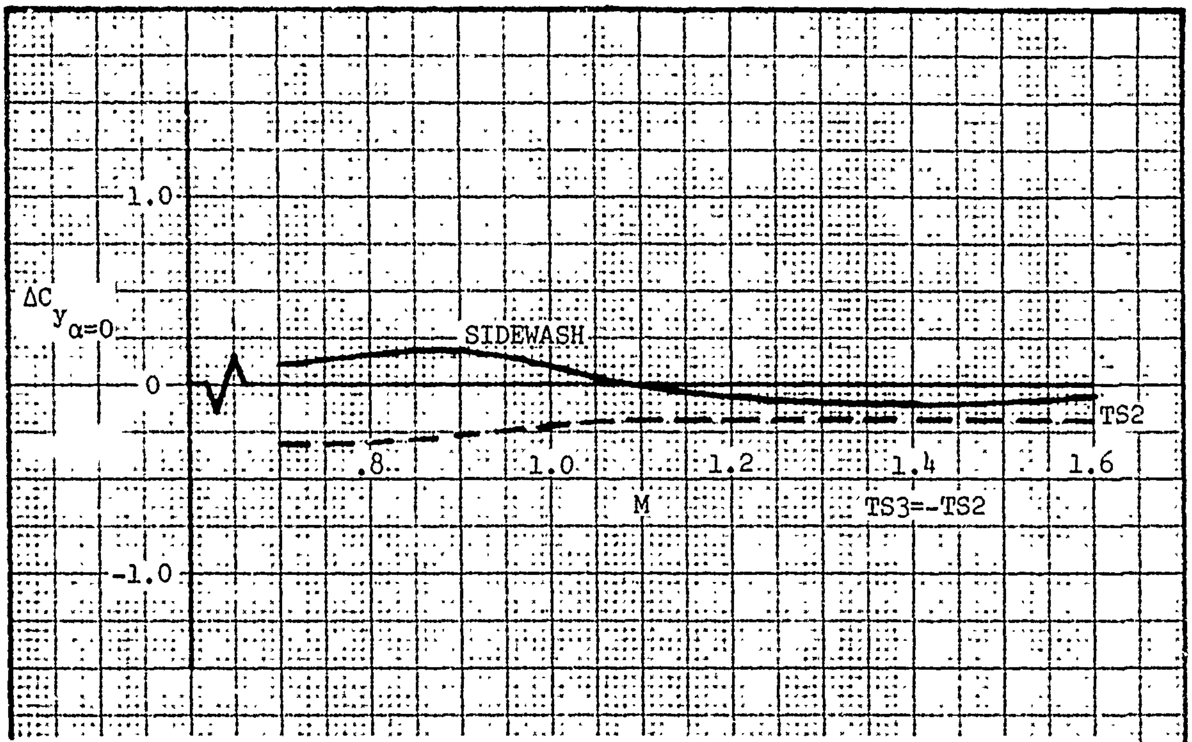


Figure 901. Side Force Intercept - Incremental Coefficient for TER Carriage

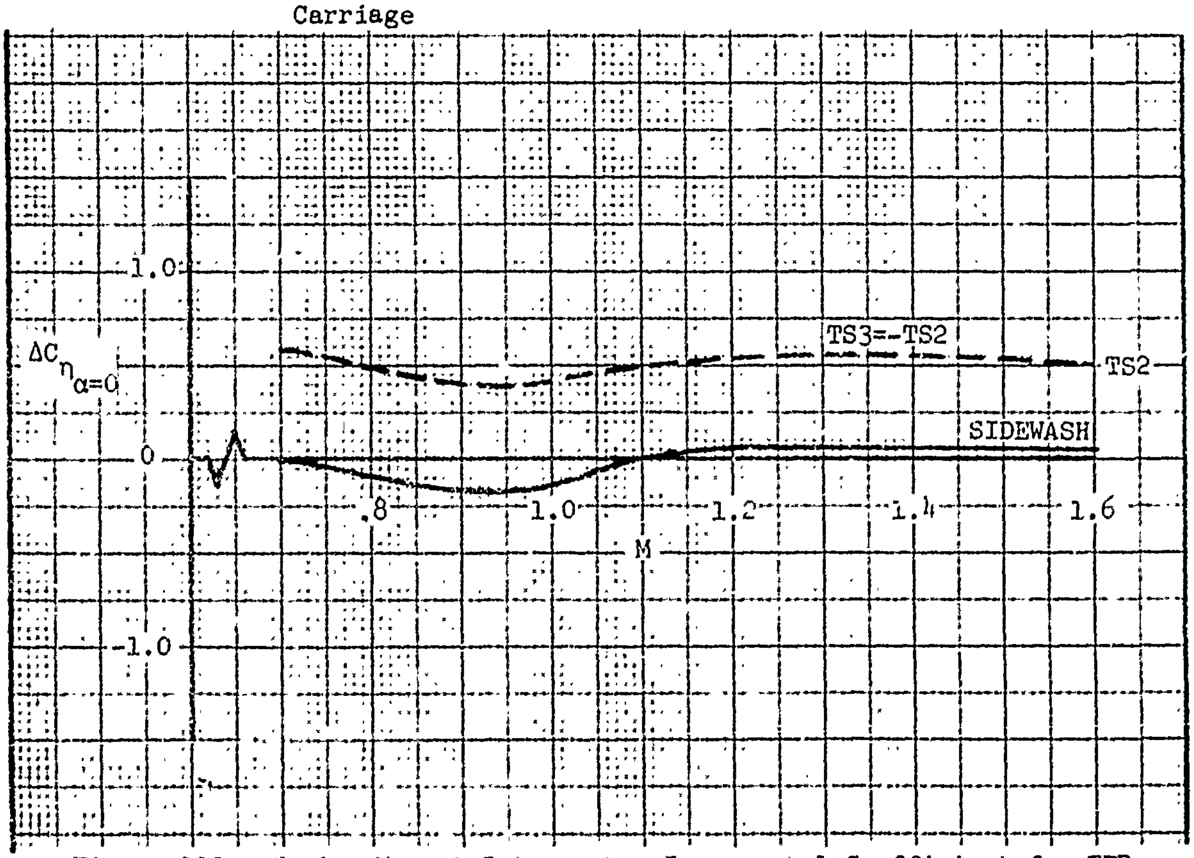


Figure 902. Yawing Moment Intercept - Incremental Coefficient for TER Carriage

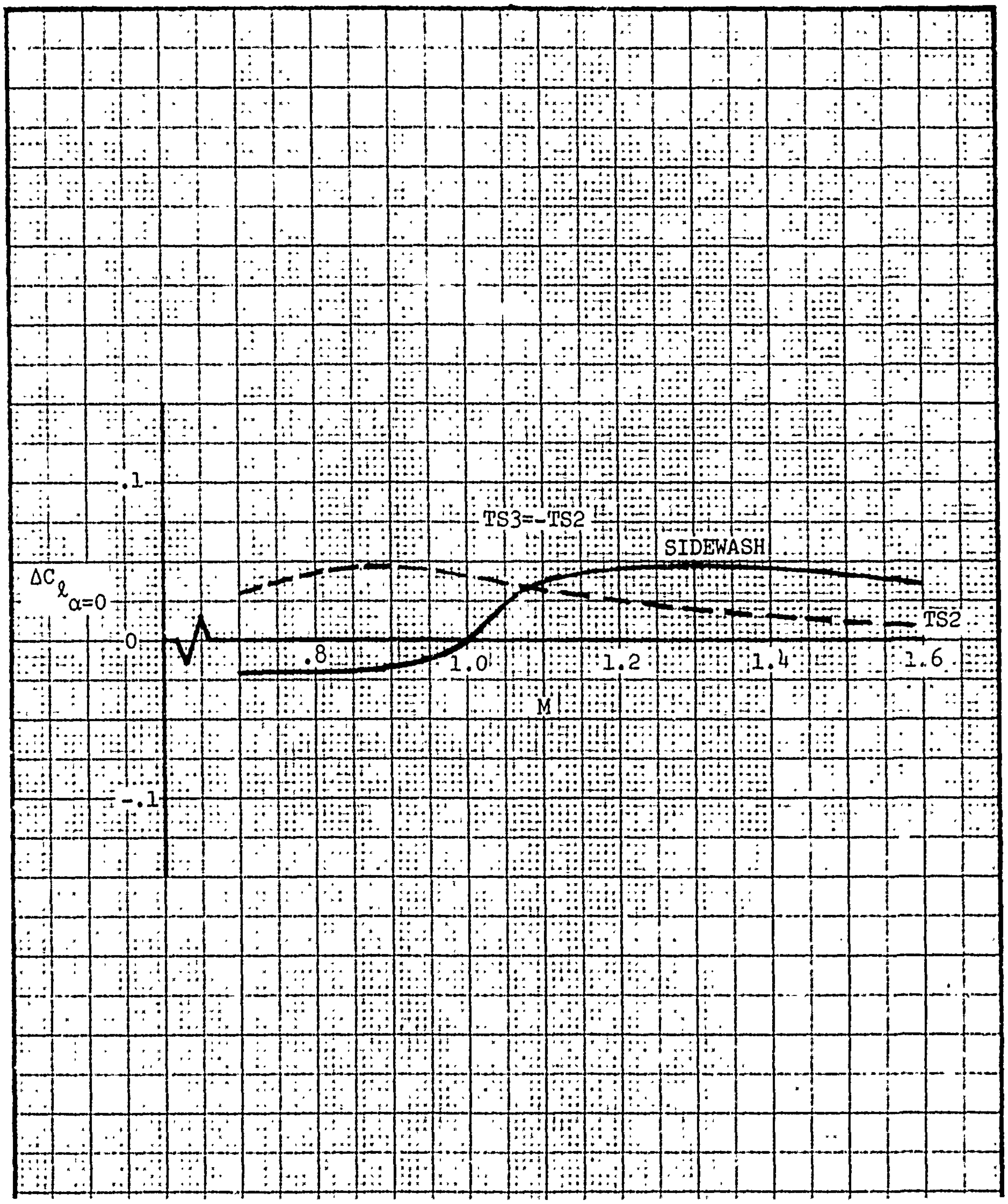


Figure 903. Rolling Moment Intercept - Incremental Coefficient for TER Carriage

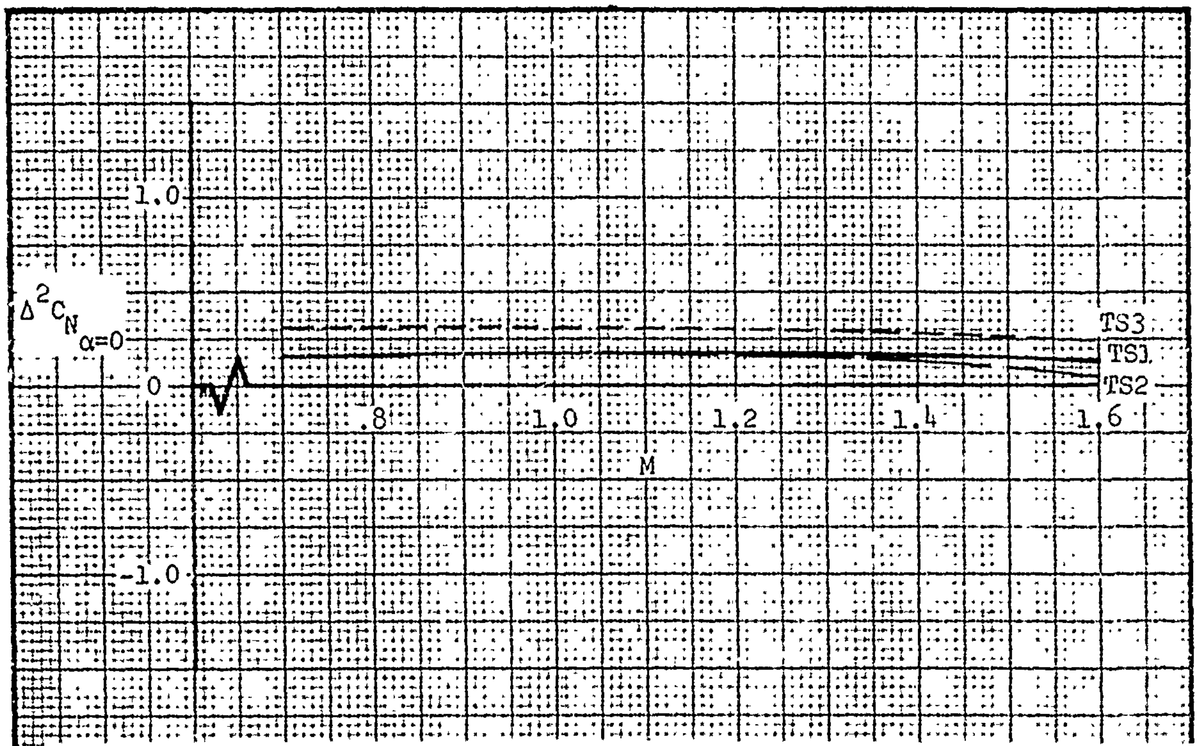


Figure 904. Normal Force Intercept - Chordwise Position Correction for TER Carriage

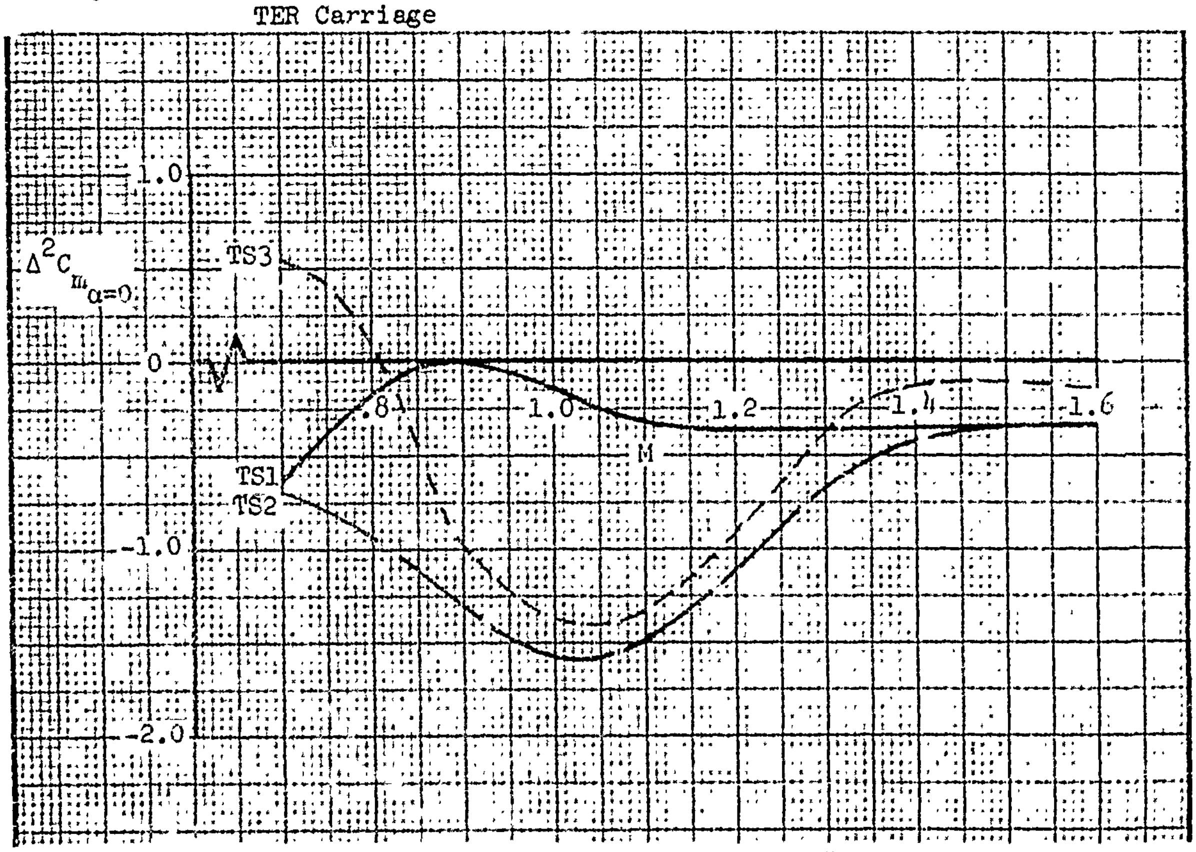


Figure 905. Pitching Moment Intercept - Chordwise Position Correction for TER Carriage

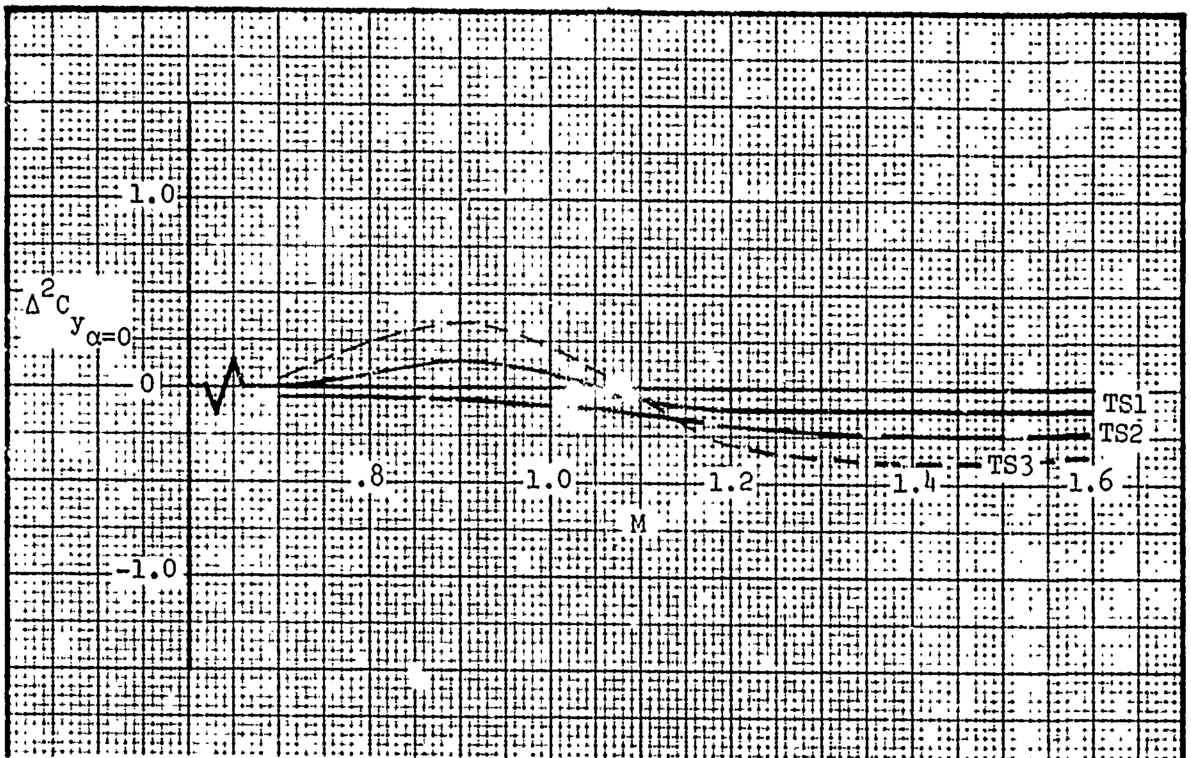


Figure 906. Side Force Intercept - Chordwise Position Correction for TER Carriage

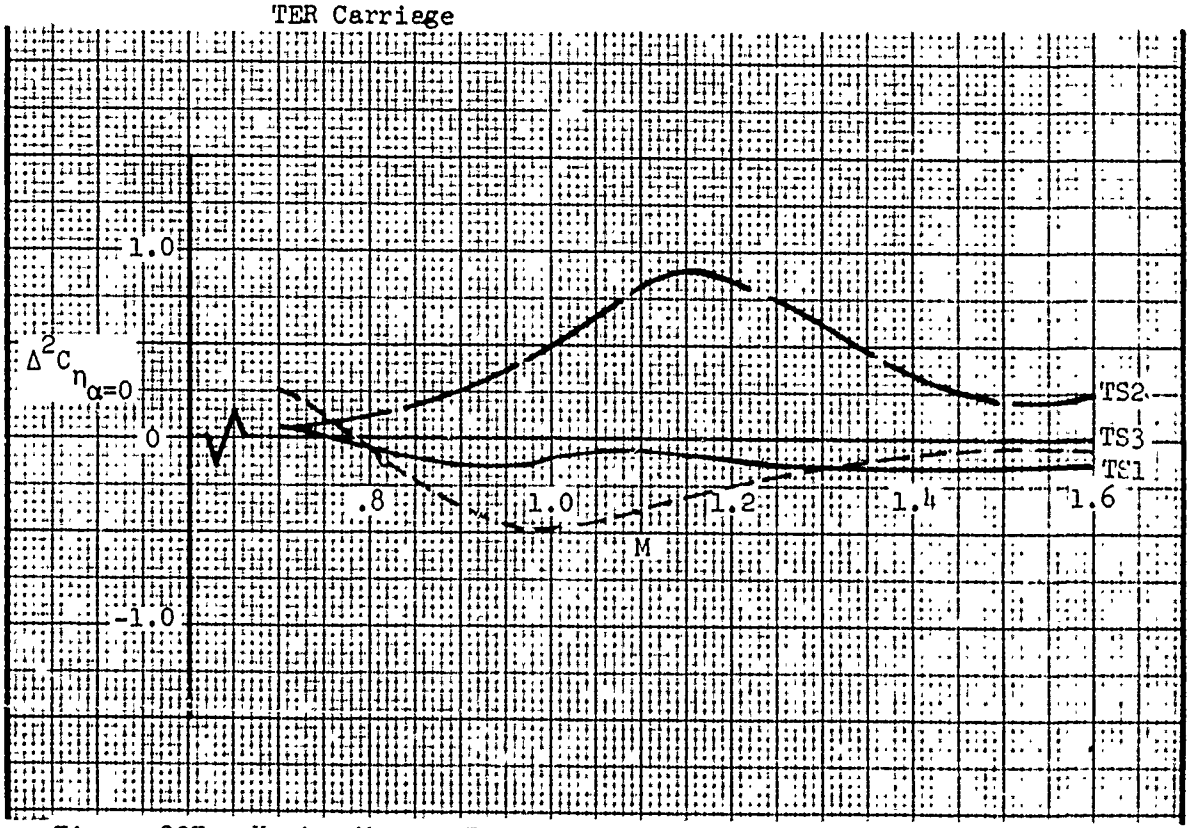


Figure 907. Yawing Moment Intercept - Chordwise Position Correction for TER Carriage

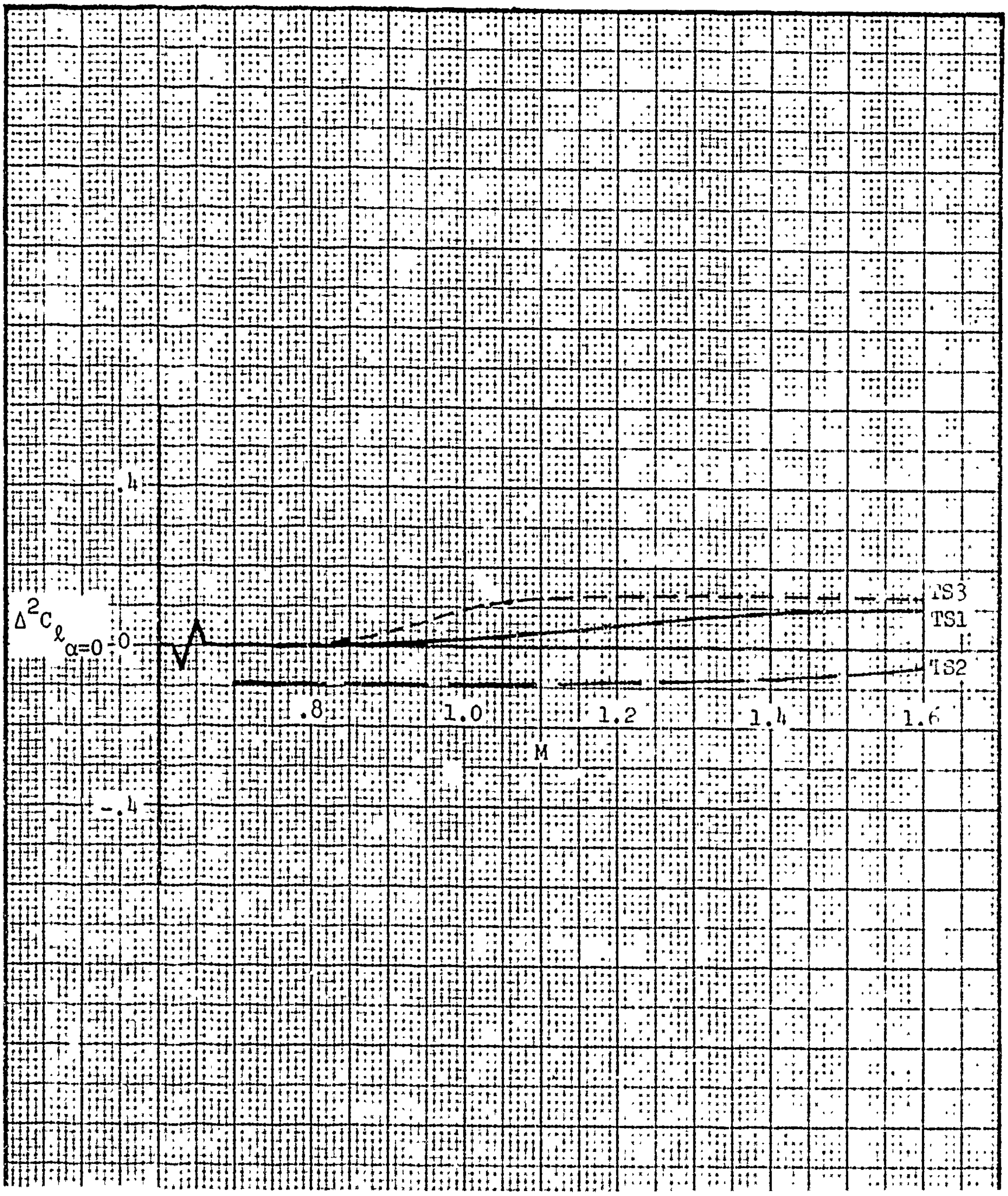


Figure 908. Rolling Moment Intercept - Chordwise Position Correction for TER Carriage

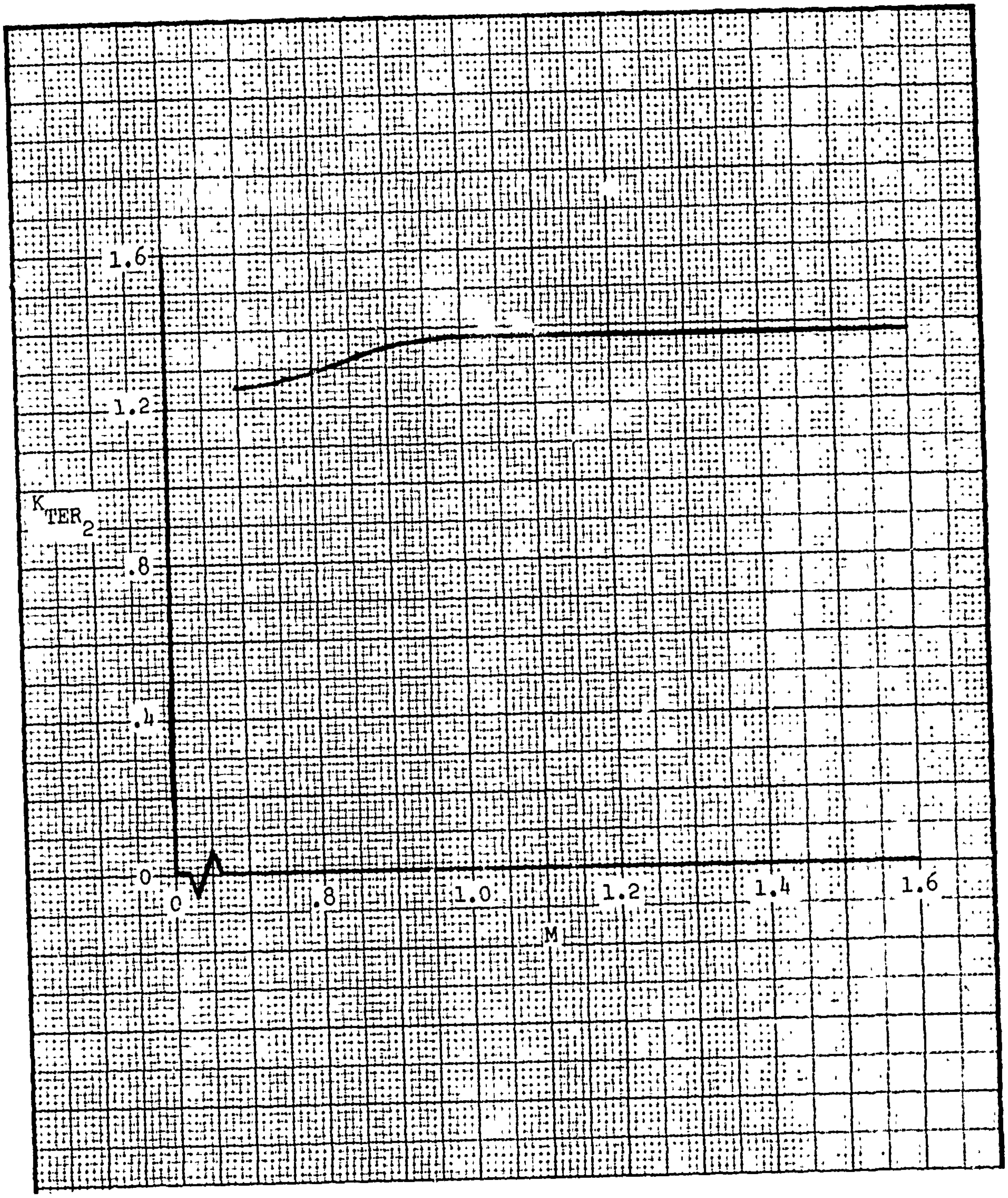


Figure 909. Axial Force Intercept Correction for TER Carriage

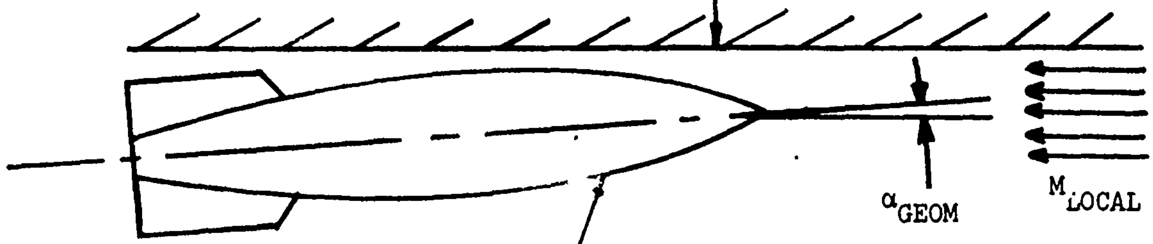
SECTION VI

OTHER CONFIGURATIONS

Sections III, IV, and V presented an airloads prediction technique for wing-mounted single stores, wing/fuselage-mounted fully loaded MER racks, and wing/fuselage-mounted fully loaded TER racks, respectively. The need is recognized, however, for the capability of predicting airloads on configurations for which the prediction technique was not developed. Hence, the purpose of this section is to provide the user with a more versatile prediction capability by making recommendations for applying the results contained in this report to configurations for which the predictions methods were not originally intended and to configurations that may arise in the future due to new rack designs. This extended capability is admittedly cursory and limited data were available to support the derivation; however, extensive store airloads correlation experience indicates the approach is justified for general prediction purposes.

6.1 SINGLE CARRIAGE FUSELAGE CENTERLINE PREDICTION

Only a small amount of data were made available for correlations applicable to fuselage stations. In fact, only one configuration was found to be of value during the correlation effort. It was not included as part of the data base during the correlation because the single configuration was determined through analysis to exert too large an influence on the remainder of the data base, thereby decreasing the accuracy of the prediction technique as a whole if it were included. Analysis of this single usable fuselage centerline carriage configuration has led to several conclusions which are incorporated in the prediction equations presented below. The most important characteristic of the data is the limited variance in local flow angularity with aircraft angle of attack. The primary reason for this is the flow boundary provided by the fuselage surface. The flow will follow the fuselage for all reasonable angles of attack. This physical requirement presents a relatively constant flow-field to the store carried on the fuselage centerline as shown in the sketch below.



As a result of this constancy in flow angularity, the rate of change of the force and moment components with aircraft angle of attack are either zero or very small compared with the wing stations. The suggested prediction equations for predicting fuselage centerline single carriage configurations are therefore presented below.

NORMAL FORCE:

SLOPE:

$\left(\frac{NF}{q}\right)_\alpha = 0$, due to the small local flow-field variance with aircraft angle of attack

INTERCEPT:

$$\left(\frac{NF}{q}\right)_{\alpha=0} = \left(\frac{NF}{q}\right)_{\alpha_{ISO}} \cdot \alpha_{GEOM}$$

where:

$\left(\frac{NF}{q}\right)_{\alpha_{ISO}}$ - Isolated aerodynamic characteristics of the subject store at the Mach number of interest, equal to $C_{L_{\alpha_{ISO}}} \cdot S_{REF}$, ft^2 /deg , as predicted from Reference 1. $S_{REF} = \frac{\pi d^2}{4}$, ft^2 , the store reference area where d is the store maximum diameter.

α_{GEOM} - Geometric angle of attack as measured from the store longitudinal axis to the surface of the aircraft fuselage, positive store nose-up

PITCHING MOMENT:

<u>SLOPE (FINNED STORES)</u>: Moment reference point assumed to be on store longitudinal axis at the mid-lug point.

$$\left(\frac{PM}{q}\right)_{\alpha} = 0.046\ S_{REF}d,\ \frac{ft^3}{deg}$$

where:

S_{REF} - Store reference area, $\frac{\pi d^2}{4}$, ft^2

d - Store reference length = maximum diameter

<u>INTERCEPT (FINNED STORES):</u>

$$\left(\frac{PM}{q}\right)_{\alpha=0} = \bar{x}_{CP}\left(\frac{NF}{q}\right)_{\alpha=0} d$$

where:

$\bar{x}_{CP}$ = -2.6 for M = 0.5 to 0.8

= -3.9 for M = 0.81 to 2.0

$\left(\frac{NF}{q}\right)_{\alpha=0}$ - Value predicted above.

d - Store reference length = maximum diameter,

SLOPE (UNFINNED STORES):

Due to the absence of store fins the store center of pressure will most likely be forward of the mid-lug point due to the more effective lift of the store nose. The pitching moment rate of change with aircraft angle of attack, $\left(\frac{PM}{q}\right)_{\alpha}$, can be even more positive than that presented for the finned case; however, in the absence of substantiating data, it will be made the same.

$$\left(\frac{PM}{q}\right)_{\alpha} = .046\ S_{REF} \cdot d,\ \frac{ft^3}{deg}$$

where:

S_{REF} and d have been defined above.

INTERCEPT (UNFINNED STORES):

Because of the forward center of pressure shift due to the absence of store fins, the pitching moment intercept, $\left(\frac{PM}{q}\right)_{\alpha=0}$, is given by the equation below.

$$\left(\frac{PM}{q}\right)_{\alpha=0} = \bar{x}_{CP}\left(\frac{NF}{q}\right)_{\alpha=0} d\ ,\ ft^3.$$

where:

$\bar{x}_{CP}$ = 2.0 for M = 0.5 to 0.8
= 1.0 for M = 0.81 to 2.0

$\left(\frac{NF}{q}\right)_{\alpha=0}$ - Value predicted above

d - Store reference length = maximum diameter

SIDE FORCE, YAWING MOMENT, ROLLING MOMENT:

These components are zero for the basic airload cases due to store symmetry about the fuselage centerline. For stores carried on the fuselage but displaced from the centerline, significant forces and moments may be developed due to the influence of the fuselage shape on the local flowfield.

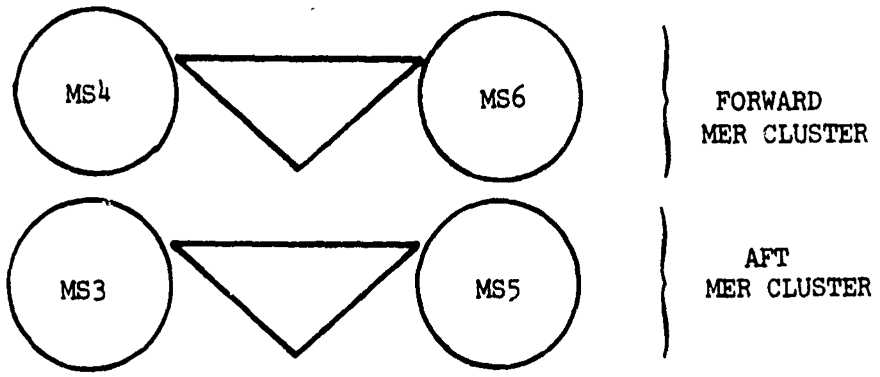
AXIAL FORCE:

The axial force slope and intercept can be estimated by using the free-stream method presented in Reference 2 and applying a factor of 1.5 to the results of the isolated computation for both slope and intercept.

6.2 MULTIPLE CARRIAGE ADDITIONAL CONFIGURATIONS

6.2.1 MER Downloads (Partially Loaded Racks)

Consider the example case where MER Stations 1 and 2 are not loaded on the MER leaving stations 3,4,5 and 6, which is a typical store drop sequence. This loading is illustrated in the sketch below.



The airloads on the remaining loaded stores can be predicted in the following manner.

MER STATIONS 3,4 (Inboard Shoulder Stations):

For the airloads on stations 3 and 4, use the predictions presented in Section IV for MER Stations 1 and 2 with outboard to inboard interference corrections (due to the presence of MS5,6 stores) for each component. The interference corrections used for MS3,4 should be those presented for adjacent shoulders in Section IV for the airload components of interest.

MER STATIONS 5,6 (Outboard Shoulder Stations):

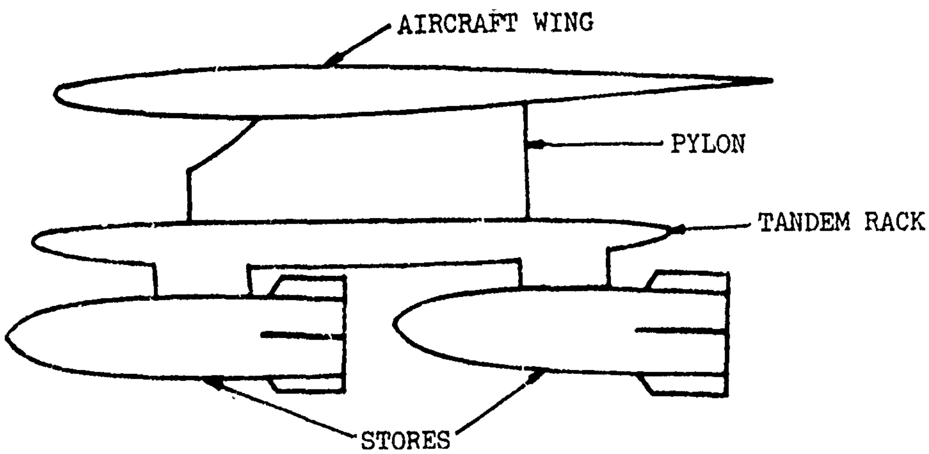
For the airloads on stations 5 and 6, use the predictions presented in Section IV for MER Stations 1 and 2 with inboard to

outboard interference corrections (due to the presence of MS3,4 stores) for each component. The interference corrections used for MS5,6 should be those presented for adjacent shoulders in Section IV for the airload components of interest.

6.2.2 New Multiple Carriage Rack Designs

TANDEM RACK

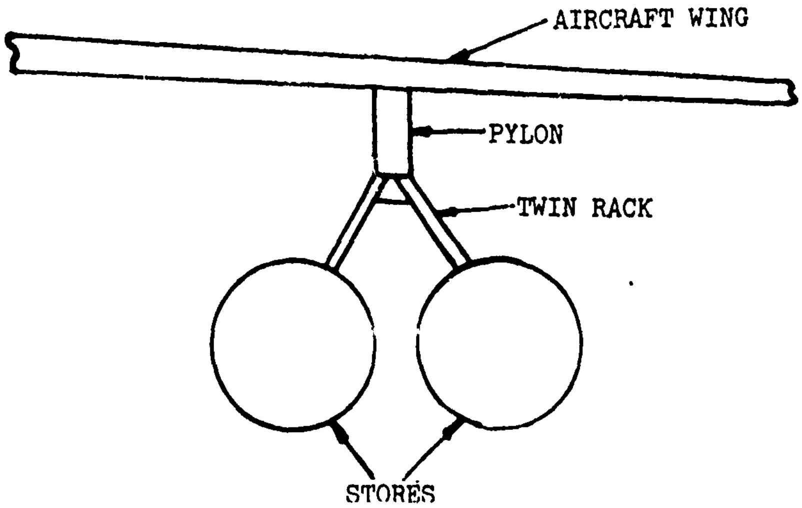
Consider a multiple carriage rack designed to carry two stores in a tandem arrangement as shown in the sketch below.



The airloads for this rack arrangement can be estimated by applying the predictions presented in Section IV for MER Stations 1 and 2 for the airload components of interest.

TWIN RACK

Consider a multiple carriage rack designed to carry two stores in a side-by-side arrangement as shown in the sketch below.



The airloads for this carriage arrangement can be predicted using the single carriage technique presented in Section III for either store in the sketch. The procedure should be to predict the airloads on the store of interest assuming the remaining store is not present, and then add the incremental airloads due to the adjacent interference effect of the other store through the procedures outlined for each component in Section III.

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GLOSSARY OF TERMS

MS, MER STA	Prefix to MER Station number. For this report, MS3,4 are the inboard shoulder stores and MS5,6 are the outboard shoulder stores.
TS, TER STA	Prefix to TER Station number. For this report, TS2 is the inboard shoulder store and TS3 is the outboard shoulder store.
Adj. Shoulder	The shoulder store on a multiple rack nearest the subject interfering store
Opposite Shoulder	The shoulder store on a multiple rack furthest from the subject interfering store

LIST OF SYMBOLS

AF	Axial force, lb
b	Aircraft wing span
C_A	Axial force coefficient, $\frac{AF}{qS_{REF}}$
C_ℓ	Rolling moment coefficient, $\frac{RM}{qS_{REF}\ \ell_{REF}}$
C_m	Pitching moment coefficient, $\frac{PM}{qS_{REF}\ \ell_{REF}}$
C_N	Normal force coefficient, $\frac{NF}{qS_{REF}}$
C_y	Side force coefficient, $\frac{SF}{qS_{REF}}$
C_n	Yawing moment coefficient, $\frac{YM}{qS_{REF}\ \ell_{REF}}$
C_{LOCAL}	Aircraft local wing chord length
cp	Center of pressure
d	Store maximum diameter
d_{INTF}	Diameter of interfering store installation
f( )	Function of independent variable in parenthesis
K	Generalized factor
K_{NOSE}	Store nose lift efficiency factor
K_{SCALE}	Scaling factor for multiple carriage stores
K_{WING}	Store wing/fin lift efficiency factor
K_{α_ℓ}	Partial derivative of local angle of attack with respect to α, $\frac{\partial\alpha_\ell}{\partial\alpha}$

K_{Λ_1}	Aircraft wing sweep correction factor, $\frac{\sin \Lambda}{\sin 45^\circ}$
K_{Λ_2}	Aircraft wing sweep correction factor, $\frac{\cos \Lambda}{\cos 45^\circ}$
K_σ	Partial derivative of sidewash with respect to α, $\frac{\partial\sigma}{\partial\alpha}$
L	Store length
ℓ_{LE}	Distance from forwardmost point of the installed store to the wing leading edge as measured in the wing plan view (positive)
ℓ_{LE_A}	Distance from forwardmost point of the aft cluster of the installed MER to the wing leading edge as measured in the wing plan view (positive)
ℓ_{LE_F}	Distance from forwardmost point of the forward cluster of the installed MER to the wing leading edge as measured in the wing plan view (positive)
L_n	Store nose length
ℓ_{REF}	Store reference length, d, ft
M	Mach number
MI	Mach index
MS	MER Station
M_x	Mach number break point (x=0,1,2,----)
NF	Normal force, lb
PM	Pitching moment, ft -lb
PPA	Plan projected area, in^2
q	Free-stream dynamic pressure, $\frac{lb}{ft^2}$

LIST OF SYMBOLS (Continued)

RM	Rolling moment, ft -lb
SF	Side force, lb
SPA	Side projected area, in ^{2}
S_{REF}	Store reference area, $\frac{\pi d^2}{4}$, ft ^{2}
TS	TER Station
X_B, Y_B, Z_B	Store body axis coordinate system, Figure 8
x_{INTF}	Adjacent store nose overlap distance, Figure 54
x_{MOM}	Distance from centroid of store area segment to store moment reference point, Figure 12
$\bar{x}_{cp}$	Distance from store center of pressure to store moment reference point non-dimensionalized by store diameter.
$\frac{x}{c}$	Fraction of wing chord
y	Distance between pylon centerline and the fuselage for high-wing aircraft
y'	Minimum clearance between installed store and fuselage for high-wing aircraft
Y	Distance from fuselage to wing tip for high-wing aircraft
y_{INTF}	Minimum store-to-store separation distance measured in wing plan view, Figure 54
YM	Yawing moment, ft -lb
Z	Distance from lower surface of wing to bottom of pylon at the mid-lug point
α	Angle of attack, deg

LIST OF SYMBOLS (Continued)

α_ℓ	Local angle of attack, deg , Figure 3
β, β_s	Store sideslip angle positive nose outboard, deg , Figure 3
Δ	Increment
η	Fraction of wing semi-span, $\frac{y_{BL}}{b/2}$, where y_{BL} is the distance from the aircraft centerline to the centerline of the pylon, measured in the wing plan view
η'	Fraction of exposed wing semi-span for high-wing aircraft, $\frac{y'}{y}$
Λ	Aircraft wing quarter-chord sweep angle, deg
Λ_{FIN}	Store fin leading edge sweep angle, deg
σ	Sidewash angle, deg , Figure 3
Ψ	Aircraft yaw angle, positive aircraft nose right, deg

SUBSCRIPTS

AFT	Aft cluster of stores on a MER (MS1, 3 and 5)
A/C	Aircraft
Buoy	Buoyancy
C	Aircraft local wing chord
℄	Fuselage centerline
FWD	Forward cluster of stores on a MER (MS2, 4 and 6)
INST	Installed
INTF	Interference
ISO	Isolated
INTC	Value of dependent variable when the independent variable equals zero

LIST OF SYMBOLS (Concluded)

IB→OB	Inboard to outboard interference
ML	Mid-lug
OB→IB	Outboard to inboard interference
PRED	Predicted
SLOPE	Variation of dependent variable with respect to the independent variable
THEO	Theoretical
α	Differentiation with respect to angle of attack
$\alpha=0$	Value of angle of attack equals zero
ψ	Differentiation with respect to yaw angle

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